Working Papers Series

Dynamic Trade Liberalization Analysis: Steady State, Transitional and Inter-Industry Effects

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Working Papers Series
Research Department
WP 98-15

Dynamic Trade Liberalization Analysis: Steady State, Transitional and Inter-Industry Effects

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December 1998

Abstract

Despite their complexity, existing policy evaluation methods ignore many features of the real world that are pertinent for welfare analysis of trade policy. The main limitation of these methods is that they are static, which means they ignore important dynamic consequences of trade liberalization. This paper develops dynamic tools that overcome many of these weaknesses. I apply these technics to the North American Free Trade Agreement (NAFTA). My analysis suggests that while the steady state gains from NAFTA are significant, the transitional costs associated with moving to the liberalized steady state are relatively large, so that on net the trade policy produces modest welfare gains for North America.

JEL classification: F13; F41.
Key Words: NAFTA; Nontariff barrier; CGE.

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*The views expressed herein are those of the author and not necessarily those of the Federal Reserve Bank of Chicago or the Federal Reserve System.

1 Introduction

There is a long standing academic tradition of using computable general equilibrium (CGE) models to study the effects of proposed changes to U.S. trade policies.[1] Policy makers, such as the United States Trade Representative, have also relied heavily on this type of analysis when evaluating the efficacy of U.S. trade policy. This is due to the fact that CGE models clearly dominate their analytical rivals as a policy tool. For example, CGE models are able to analyze trade liberalization involving more countries and commodities than is feasible with existing analytical methods. In addition to this, CGE models are attractive because they make sharp predictions about the impact of policy changes, while their analytical counterparts are often ambiguous about the direction and magnitude of changes in prices and quantities.

Despite their complexity existing CGE models ignore many features of the real world that are pertinent for trade policy analysis. The main limitation of CGE models is that they are static, which means they ignore three important dynamic consequences of trade liberalization. First, static models limit the world supply of capital to that available in the pre-liberalization steady state. Therefore, static welfare and output gains associated with liberalization come from a reallocation of capital across sectors and countries. Static models ignore the fact that capital accumulation is generally more efficient under free trade, because tariffs on durable goods are essentially a tax on investment, and therefore understate the potential welfare and output gains that accrue from trade liberalization.

Second, static trade models rule out trade in financial assets by restricting national current accounts to be zero. These restrictions also lead CGE models to understate the welfare effects of trade liberalization, since international capital flows serve three basic purposes which directly raise national and international welfare: by trading international assets agents can achieve a higher level of welfare by maintaining smooth consumption paths while undertaking major capital investment and sectoral reallocation of factors following

[1] See, for examples, the recent conference volumes on NAFTA by Greenway and Whalley (1992), Lustig, Bosworth and Lawerence (1992), Francois and Shiells (1994), and survey by Kehoe and Kehoe (1994).

trade liberalization; international capital flows allow for more rapid adjustment to the new policy environment; and by trading international assets agents can achieve a more efficient allocation of resources across countries.

Finally, static models limit the analysis of free trade agreements to a comparison of steady states. Specifically, they provide a comparison of the pre-liberalized economy and the liberalized economy after it settles to its new longrun path. These models offer no estimate of the length of time it takes to move to the new steady state or the path of adjustment. More importantly, they ignore adjustment costs associated with reallocating labor and capital by implicitly assuming that factors of production are perfectly mobile, both nationally and internationally.

The objectives of this paper are both methodological and applied. On the methodological front, I develop a quantitative multisector dynamic general equilibrium (MDGE) model which overcomes many of the unrealistic assumptions of static CGE models and the limitations of aggregate dynamic studies of trade liberalization (see, for example, McKibbin and Salvatore 1995, and Manchester and McKibbin 1995). I do this by marrying the dynamic features of one sector international trade models, now popular in the study international business cycles, with the multisector characteristics of static CGE models. The resulting model allows for endogenous capital accumulation, explicit factor adjustment costs and international trade in financial assets. In addition, disaggregating the economy into industries allows for explicit dynamic analysis of the intersectoral reallocation of resources that is central to the trade policy debate.

My modelling approach is similar to earlier MDGE analyses by Goulder and Eichengreen (1992) and McKibbin and Wilcoxen (1995). There are however significant differences in the way these studies model household preferences. I allow for elastic labor supply, while the earlier studies limit their analysis to the case of inelastic labor supply. Another significant area of departure is the way these studies model adjustment costs. In the current paper, I allow for costs associated with adjusting the level of the aggregate capital stock, and costs associated with sectoral reallocation of capital. The earlier papers combined these margins.

I also extend the analysis by allowing explicit sectoral labor adjustment costs.

On the applied front, I use the model to evaluate the positive and normative effects of the North American Free Trade Agreement (NAFTA). This adds to other MDGE studies, such as, Goulder and Eichengreen (1992) who study unilateral liberalization in the form of the elimination of all U.S. tariffs and nontariff barriers, and McKibbin (1998) who focuses on the potential effects of regional trade liberalization by studying the elimination of tariffs within the Asian Pacific Economic Conference (APEC). More significantly the current paper makes an important methodological contribution to the study of multilateral trade liberalization by offering an explicit welfare analysis of a regional trade agreement. In particular, I provide estimates of both the steady state gains of regional trade liberalization and the transition costs associated with moving to this new longrun equilibrium.

The remainder of the paper is organized as follows. Section 2 describes the structure of my model. Section 3 discusses model calibration and other data issues. Section 4 reports model simulation results. Section 5 conducts an extensive sensitivity analysis of the model's key parameters. The paper concludes with section 6's summary of the papers main findings and suggestions for future research.

2 The model

The model developed in this paper combines the multisector characteristics of static CGE models with the dynamic characteristics of one sector international business cycle models.[2] Countries are sorted into two groups. The North American countries (Canada, Mexico and the U.S.) are modeled individually, while the remaining countries are consigned to a residual rest of the world (ROW). All countries, including the ROW, are fully specified in the sense that production, consumption, investment, work effort and trade decisions are the result of explicit optimization decisions. The inclusion of a fully specified ROW avoids the need for ad hoc residual ROW supply and demand equations (used in the partial equilibrium

[2] See the surveys of Backus, Kehoe and Kydland (1995), and Baxter (1995) for examples of one sector international real business cycle models.

model of Ho and Jorgenson 1994 and 1998) and ensures endogenous determination of all quantities and prices.

Figure 1 provides a summary of the domestic and international goods and factor flows in the model. Each country/region has five production industries: primary raw materials (1), nondurable manufactures (2), durable manufactures (3), construction (4), and services (5). Primary raw materials, nondurable manufactures and durable manufactures are traded goods, while construction and services are nontraded goods. Primary goods include agriculture and mining. Nondurable manufactures include food processing, beverages, chemicals, textiles, paper and apparel. Durable goods include basic metal and non-metal products, wood and furniture products, machinery and transportation equipment. Construction includes residential and non-residential structures. Services covers utilities, finance, insurance, real estate, transportation, and retail and wholesale activities. Note, in the following discussion industries are indexed by i and j, while countries are indexed by k and ℓ.

2.1 Preferences

Each country k has a single infinitely lived representative household that maximizes its expected lifetime utility U_k from consuming a composite consumption good (c_{kt}) and leisure (L_{kt}):

$$U_k = E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left(c_{kt}^{\theta_{ck}} L_{kt}^{1-\theta_{ck}}\right)^{1-\sigma}}{1-\sigma} \text{ for } \sigma > 0 \text{ and } \sigma \neq 1,$$

and

$$U_k = E_0 \sum_{t=0}^{\infty} \beta^t \left(\theta_{ck} \ln(c_{kt}) + (1-\theta_{ck}) \ln(L_{kt})\right) \text{ for } \sigma = 1, \tag{1}$$

and $0 < \beta < 1$, $0 < \theta_{ck} < 1$ for $\forall k$. Note, β denotes the individual's subjective rate of time discount. Consumption is an aggregate of nondurable consumption goods (c_{nkt}) and the flow of services from consumer durables (d_{kt}). Nondurable goods and the durable service flow are aggregated according to a constant elasticity of substitution (CES) function:

$$c_{kt} = \left(\omega_{ck} c_{nkt}^{1-\eta} + (1-\omega_{ck}) d_{kt}^{1-\eta}\right)^{\frac{1}{1-\eta}} \tag{2}$$

for $0 \leq \omega_{ck} \leq 1$ and $\eta > 0$ for $\forall k$. The elasticity of substitution between nondurable consumption goods and durable services is $1/\eta$, while ω_{ck} reflects the bias toward nondurables. Nondurable consumption goods are also aggregated by a CES function:

$$c_{nkt} = \left(\sum_i \omega_{cik} c_{ikt}^{1-\kappa}\right)^{\frac{1}{1-\kappa}} \tag{3}$$

for $0 \leq \omega_{cik} \leq 1, \sum_i \omega_{cik} = 1$ and $\kappa > 0$ for $\forall k$. The elasticity of substitution between individual nondurable consumption goods (c_{ikt}) is $1/\kappa$, while ω_{cik} reflects the bias toward nondurable good i.

2.2 Production technology

Following the static CGE literature I make the standard multisector assumption that gross production in sector i (y_{ikt}) is described by a two-level CES function (see, for example, Shoven and Whalley, 1992):

$$y_{ikt} = A_{ikt} \left\{\omega_{yik} va_{ikt}^{1-\varepsilon} + (1-\omega_{yik}) m_{ikt}^{1-\varepsilon}\right\}^{\frac{1}{1-\varepsilon}} \tag{4}$$

for $0 \leq \omega_{yik} \leq 1$ and $\varepsilon > 0$ for $\forall i, k$. The first level of production involves a value-added index (va_{ikt}) and an aggregate intermediate goods component (m_{ikt}). The value-added production index is described by Cobb-Douglas technology which uses capital (k_{ikt}^s), labor (N_{ikt}^s) and land (T_{ikt}) as inputs:

$$va_{ikt} = k_{ikt}^{s\alpha_{ik}} N_{ikt}^{s\theta_{ik}} T_{ikt}^{1-\alpha_{ik}-\theta_{ik}} \tag{5}$$

for $\alpha_{ik}, \theta_{ik} \geq 0$ and $\alpha_{ik} + \theta_{ik} \leq 1$ for $\forall i, k$.

The other factor of production is the aggregate intermediate input, which is a composite of intermediate inputs from all sectors. Specifically, these factors are aggregated according to the following CES function:

$$m_{ikt} = \left(\sum_j \alpha_{ijk} m_{ijkt}^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}} \tag{6}$$

for $0 < \alpha_{ijk} < 1, \sum_j \alpha_{ijk} = 1$ and $\varepsilon > 0$ for $\forall i, k$. m_{ijkt} denotes the flow of intermediate goods from sector j to sector i. The elasticity of substitution between value-added and all intermediate inputs in sector i is $1/\varepsilon$. A_{ikt} is an exogenous productivity shift parameter in sector i, which is held constant throughout the policy simulations.

2.3 Investment behavior

Capital goods There are two types of investment goods in this model. The first are durable capital goods that depreciate at rate $0 < \delta \leq 1$. Capital goods are either used as inputs in the production of goods (k_{kt}) or as household durables (d_{kt}). Production capital (i_{kkt}) and household durable (i_{dkt}) investment is a composite of durable manufactures (i_{3kt}), construction (i_{4kt}) and service (i_{5kt}) goods. Investment goods are aggregated according to a CES function:

$$i_{kkt} + i_{dkt} = \left(\sum_j \omega_{ijk} i_{jkt}^{1-\upsilon} \right)^{\frac{1}{1-\upsilon}} \tag{7}$$

for $0 < \omega_{ijk} < 1$, $\sum_j \omega_{ijk} = 1$ and $\upsilon > 0$ for $\forall k$. The elasticity of substitution between investment goods is $1/\upsilon$, while ω_{ijk} reflects the bias toward good j.

I assume there are costs of adjusting aggregate capital stocks in all regions. Following Baxter and Crucini (1993), I employ a convex aggregate cost of adjustment function where: $\phi_k(x) > 0, \phi_k'(x) > 0$, and $\phi_k''(x) < 0$. Using this notation I can describe accumulation of country $k's$ capital and household durables by the following:

$$k_{kt+1} = \phi_k \left(\frac{i_{kkt}}{k_{kt}} \right) k_{kt} + (1 - \delta) k_{kt} \text{ for } \forall k \tag{8}$$

$$d_{kt+1} = \phi_k \left(\frac{i_{dkt}}{d_{kt}} \right) d_{kt} + (1 - \delta) d_{kt} \text{ for } \forall k \tag{9}$$

I also allow for there to be costs of adjusting sectoral capital stocks. I employ a convex sectoral cost of adjustment function where: $\phi_{ki}(x) > 0, \phi'_{ki}(x) > 0$, and $\phi''_{ki}(x) < 0$. Using this notation I can describe sector $i's$ service flow from capital:

$$k^s_{ikt} = \phi_{ki}\left(\frac{k_{ikt}}{k_{kt}}\right) k_{kt} \text{ for } \forall i, k \tag{10}$$

$$k_{kt} = \sum_i k_{ikt} \text{ for } \forall i, k \tag{11}$$

Intermediate goods The second category of investment goods are intermediate goods (m_{ijkt}), which are held as inventories and completely consumed in the production of future goods. The time period in the model is quarterly. Empirical evidence (see Ramey (1989) for details) suggests intermediate goods require one period to put in place. Based on this I assume period $t+1$ intermediate inputs are produced in period t.

2.4 Trade flows

The model allows for trade between the North American countries and the ROW. Where the ROW is a composite of Canadian, Mexican, and U.S. trading partners. Let $x_{ik\ell t}$ denote country k's private consumption/use of good i produced in country ℓ. In other words, $x_{ik\ell t}$ denotes country k's imports of good i from country ℓ. The private final expenditure aggregation function for good i is a CES function given by the following:

$$c_{ikt} + i_{ikt} + \sum_j m_{jikt+1} = \left(\sum_\ell \omega_{ik\ell} x^{1-\mu_i}_{ik\ell t}\right)^{\frac{1}{1-\mu_i}} \tag{12}$$

for $0 \leq \omega_{ik\ell} \leq 1$, $\sum_\ell \omega_{ik\ell} = 1$ and $\mu_i > 0$ for $\forall i, k$.[3] Recall c_{ikt} describes nondurable consumption of good i, i_{ikt} capital investment, and m_{jikt} the flow of intermediate goods from sector i to sector j. The elasticity of substitution between home produced and all imported goods is $1/\mu_i$, while $\omega_{ik\ell}$ reflects bias toward country ℓ's good i.

[3] Differentiating goods by location is necessary to rule out complete specialization. See Baxter (1992) for a discussion of how complete specialization, along the lines of Ricardian comparative advantage, emerges in a dynamic Heckscher-Ohlin-Samuleson model where goods are not differentiated by production location.

2.5 Government

Each country has a government which imposes tariffs on imported goods. The tariff rate in country k for good i imported from country ℓ is $\tau_{ik\ell t}$. It is difficult to model nontariff barriers (NTBs) directly, so I take the standard approach of employing so called tariff equivalent NTBs (that is, the level of tariff protection that yields the same level of output and trade as the NTB). The tariff equivalent NTB for good i imported from country ℓ is $\rho_{ik\ell t}$. The tax revenue from the tariff and the quota rents from the NTBs are rebated by lump-sum payments, denoted by TR_{kt} and QR_{kt} respectively. The government also levies a lump-sum tax T_{kt} to finance its current spending. By allowing $p_{i\ell t}$ to denote the price of country ℓ's good i in terms of the numeraire good I can describe country k's government budget constraint:

$$\sum_{\ell}\sum_{i} p_{i\ell t} g_{ik\ell t} + TR_{kt} + QR_{kt} = \sum_{\ell \neq k}\sum_{i} (\tau_{ik\ell t} + \rho_{ik\ell t}) p_{i\ell t} x_{ik\ell t} + T_{kt} \tag{13}$$

$$TR_t = \sum_{\ell \neq k}\sum_{i} \tau_{ik\ell t} p_{i\ell t} x_{ik\ell t} \tag{14}$$

$$QR_t = \sum_{\ell \neq k}\sum_{i} \rho_{ik\ell t} p_{i\ell t} x_{ik\ell t} \tag{15}$$

The last element of final expenditure is government spending. For simplicity I assume that the public sector has the same aggregation function as the private sector.[4]

$$g_{ikt} = \left(\sum_{\ell} \omega_{ik\ell} g_{ik\ell t}^{1-\mu_i} \right)^{\frac{1}{1-\mu_i}} \quad \text{for } \forall i, k \tag{16}$$

where $g_{ik\ell t}$ is the country k's governments consumption of good i from country ℓ. Combining these results implies $T_{kt} = \sum_{\ell}\sum_{i} p_{i\ell t} g_{ik\ell t}$. Note, real government spending is held constant in the trade policy simulations.

[4]Backus, Kehoe and Kydland (1995) make a similar assumption in a dynamic one sector model of international trade.

2.6 Resource constraints

The model contains two non-reproducible factors, labor (N_{kt}) and land (T_{kt}). Labor is mobile between sectors (N_{ikt}) within in a country, subject to small adjustment costs. Following the approach to capital adjustment costs I employ a convex cost of adjustment function where: $\phi_{Ni}(x) > 0, \phi'_{Ni}(x) > 0$, and $\phi''_{Ni}(x) < 0$. Using this notation I can describe sector $i's$ service flow from labor:

$$N^s_{ikt} = \phi_{Ni}\left(\frac{N_{ikt}}{N_{kt}}\right) N_{kt} \text{ for } \forall i, k \tag{17}$$

$$N_{kt} = \sum_i N_{ikt} \text{ for } \forall i, k \tag{18}$$

Total hours are normalized to unity so that agents face the following labor constraints:

$$1 - L_{kt} - N_{kt} = 0 \text{ for } \forall k \tag{19}$$

Land is only a factor of production in the primary sector. The supply of land is held constant in the policy experiments reported in the next section.

The only financial assets available to agents in country k are noncontingent one period bonds b_{kt}. The price of these assets in terms of the numeraire good is p_{bt} (note, throughout the paper I maintain ROW nondurable manufactured goods as the numeraire, $p_{2rt} = 1$). With this notation in hand I can describe country k's representative household's intertemporal budget constraint as:

$$\sum_i p_{ikt}y_{ikt} + b_{kt} + QR_{kt} + TR_{kt} = \begin{array}{l} \sum_{\ell \neq k} \sum_i (1 + \tau_{ik\ell t} + \rho_{ik\ell t}) p_{i\ell t} x_{ik\ell t} \\ + \sum_i p_{ikt} x_{ikkt} + p_{bt} b_{kt+1} + T_{kt}, \text{ for } \forall k \end{array} \tag{20}$$

Each regional economy is also subject to the following sectoral resource constraints:

$$y_{ikt} = \sum_\ell x_{ik\ell t} + g_{ik\ell t} \text{ for } \forall i, k \tag{21}$$

Finally, regional economies are subject to the following international bond market constraint:

$$\sum_k b_{kt} = 0 \tag{22}$$

2.7 Equilibrium and model solution

I follow Baxter and Crucini's (1995) approach to solving dynamic trade models in which foreign assets are restricted to one period bonds. In each country, the representative household owns all productive inputs. Each period the household rents these productive inputs to the various firms in the same economy. Firms produce all five goods and sell the output to households in all four countries/regions. In each country/region the representative household's dynamic optimization problem is to maximize the expected lifetime utility described by (1) subject to the constraints given by equations (2) to (20). The competitive equilibrium is described by the stochastic processes for capital, labor, consumption, investment and their associated prices that satisfy the regional representative households optimization problems and the market clearing conditions given by (21)–(22). I use numerical techniques to solve for the model's dynamic equilibria. Specifically, the log-linear approximation technique advanced in the real business cycle (RBC) literature by King, Plosser and Rebelo (1988, 1990).

3 Data and benchmark parameters

The model must be parameterized before I can apply numerical solution methods. Direct estimation of all the model's parameters is ruled out by the fact that there is insufficient international data to estimate all preference, production, and trade parameters. Researchers working with CGE models have overcome this problem by using model calibration (see, for example, Shoven and Whalley 1992). More recently this approach has been extended to dynamic models of international trade (see, for example, Baxter 1995). Calibration essentially involves two steps. First, the researcher chooses a set of elasticities that describe the degree of substitution in consumption, production, and trade. Second, given this set of elasticities the researcher chooses weighting terms in preference, production, and trade aggregation functions so that the model's steady state corresponds to a specific point in time. In my case the model's base year or pre-NAFTA steady state is assumed to be 1992, the year the three countries signed the initial NAFTA proposal.

One of the strategies I follow is to calibrate my model using elasticities from a benchmark static study. This allows for a convenient comparison of the results from my dynamic study with those of a well-known static analysis. My benchmark static study is Brown, Deardorff and Stern (1992). They undertake a similar policy experiment, with a model that has similar multisector characteristics to my dynamic model. On the dynamic front, I draw heavily on the parameter set used in the RBC literature. The model's parameters are summarized in Table 1.

Preferences Household parameters are based on individual country national accounts data and parameters used in the CGE and RBC literature. Following the RBC literature I set the curvature parameter σ to 2, the consumption/leisure share parameter θ_{ck} to be consistent with 20 percent of the agents total time being devoted to market activity, and the subjective discount factor β to 0.9852 (which implies a quarterly interest rate of about 1.5 percent). My benchmark set of elasticities of substitution for household durables $(1/\eta)$ and nondurables $(1/\kappa)$ are set to unity (that is, nested preferences are Cobb-Douglas), this follows Brown, et al. (1992). Finally, the bias terms (ω_{ck} and ω_{cik}'s) are calibrated so that they are consistent with these elasticities and disaggregated national accounts data for household consumption and investment expenditure.

Production The description of production in the previous section follows the static CGE literature by assuming a two level CES structure, with a Cobb-Douglas value-added component and intermediate goods aggregated by a CES function. I parameterize these production functions using the cost function estimates of Ramey (1989). Ramey estimates production functions for various manufactured goods using quarterly U.S. data. Her production functions include labor, capital and inventories of raw material, work-in-progress and finished goods. Combining her results with the theoretical results in Sato (1969) I find that the constant elasticity of substitution between intermediate inputs and the value-added component $1/\varepsilon$ is roughly 0.1 at the quarterly frequency, which suggests the quarterly production function is close to Leontief. Note, static CGE models typically restrict production to be Leontief with zero elasticities of substitution. All other production parameters ($\omega_{yik}, \alpha_{ik}, \theta_{ik}$ and α_{ijk}'s) are derived from the most recent input-output table for Canada, Mexico and the U.S. The ROW is predominantly industrial country based so I model their production functions using U.S. input-output data.

Investment The quarterly depreciation rate δ is set at 2.5 percent, which is consistent with most quarterly RBC studies. Following Baxter and Crucini (1993) I set the aggregate capital adjustment cost function so that: its steady state value is equal to the steady state ratio of investment to capital; in steady state Tobin's q (the ratio of the price of existing capital to the price of new capital) is one; and the elasticity of the aggregate investment-capital ratio with respect to its Tobin q is consistent with aggregate investment volatility levels (I follow many other international real business cycle studies in setting this elasticity to 10). The sectoral capital adjustment costs functions are modelled in a similar way except that: in steady state their value is equal to the steady state ratio of sectoral capital to aggregate capital; in steady state the ratio of sectoral and aggregate capital rental rates are unity; and the elasticity of sectoral capital-total capital ratios with respect to their relative rental rates is set so that they are consistent with sectoral investment volatilities (my estimates are based on the multisector international real business cycle analysis of Kouparitsas, 1996). The aggregate and sectoral labor adjustment cost functions are calibrated in a similar fashion. The primary sector has the highest adjustment costs, which is consistent with the view that primary capital and labor tend to be industry specific.

There is a wide range of estimates on the degree of substitution between different types of household and industrial durable goods. I follow the CGE literature's approach to nondurable aggregation by setting the elasticity of substitution between different types of durable goods to unity. The bias terms (ω_{ijk}'s) are calibrated so that they are consistent with these elasticities and disaggregated national account data for expenditure on investment goods.

Trade barriers Explicit tariff rates are readily available from various national and international trade organizations and previous static studies. In contrast, it is difficult to incorporate NTBs such as quotas and other non-price restrictions in CGE models, so researchers use so-called tariff equivalent measures of NTBs in their quantitative analysis. Table 2 provides an overview of Roland-Host, Reinert and Shiells' (1992, 1994) comprehensive estimates of the levels of tariff and tariff equivalent NTB protection that existed prior to the signing of the Canada U.S. free trade agreement (CFTA) and NAFTA in 1988. For comparability with earlier static analyses I set the level of pre-NAFTA protection in my model to match Roland-Holst et al.'s estimates. Tariff equivalent NTBs greatly exceed explicit tariff levels, which suggests that NTBs represent the highest barrier to free-trade. NAFTA calls for the removal of all North American trade barriers. My results show that the gains from the removal of NTBs under NAFTA far outweigh the gains from removing explicit tariffs.

NAFTA followed the signing of a far-reaching CFTA in 1989, which was designed to eliminate all trade barriers between Canada and the U.S., described in Table 2. Therefore, I model NAFTA as the joint free trade agreement between Canada and Mexico, and the U.S. and Mexico. In practical terms NAFTA involves the removal of barriers to (1) Mexican exports to Canada and the U.S. and (2) Canadian and U.S. exports to Mexico. As the majority of tariff reductions will take place within 10 years I model NAFTA as the uniform reduction of protection levels over a 10-year period (that is, protection levels are reduced by 10 percent each year) starting the first quarter of 1994. Model simulations begin in the period following the signing of the initial NAFTA agreement, first quarter of 1993. I conduct the NAFTA simulations as if agents in the world economy fully anticipated the path of trade liberalization described above. This implicitly assumes that agents knew at the date of the initial signing, December 17, 1992, that NAFTA would be ratified in late 1993, implemented in the first quarter of 1994, and phased in slowly over 10 years.

One of the sticking points in passing the NAFTA in Congress was its potential negative effect on sensitive industries such as agriculture and automobile production. Policy makers dealt with this issue by allowing for a 15 year lowering of trade barriers for these industries. I look at the effects of adopting a 15 versus a 10 year policy in my sensitivity analysis. I also consider the welfare effects of an immediate lowering of barriers after the signing of the agreement. This is the assumed policy of static analysis. My estimates suggest that there are significant welfare implications associated with the speed at which trade barriers are lowered.

Trade flows There are a wide range of estimates of the elasticity of substitution between home and foreign goods ($1/\mu_i$'s) used in the quantitative trade literature. My starting point is to adopt the same elasticities used in Brown, et al. (1992). They impose an elasticity of 3, suggesting a reasonably high level of substitution between home and foreign goods. In my sensitivity analysis I allow for lower and higher degrees of substitution. The lower elasticities are approximately unity and come from empirical studies by Shiells and Reinert (1993) for Canada and the U.S., and Sobarzo (1994) for Mexico. This is my preferred parameter set because the NTB equivalent tariff rates estimated by Roland-Host, et al. (1992, 1994) are generated by a static model that uses this set of elasticities. I do not use these elasticities in my benchmark model because Roland-Host, et al. study a broader NAFTA than the one studied in this paper, which makes direct comparison of their results impossible. It is important to note that the simulation results depend critically on these elasticities of substitution. Specifically, trade liberalization generates significantly lower welfare effects if there is a low degree of substitution between home and foreign goods.

The trade aggregation parameters $\omega_{ik\ell}$ are calibrated to match 1992 trade flow statistics for the 4 countries/regions. There are three things to note about North American trade flows. First, Canada-Mexico is trade quite small. Their bilateral trade accounts for about 1-2 percent of their export and import baskets. Second, trade with the U.S. represents a large share of Canadian and Mexican trade (in the order of 70 percent of their import and export baskets). Finally, trade with Canada and Mexico is less important to the U.S., in fact, more than 70 percent of U.S. trade is with countries outside North America. This largely reflects the U.S.'s considerably larger size relative to its North American counterparts. Based on these statistics NAFTA was expected to have a small impact on the U.S. and Canadian economies, and a large impact on the Mexican economy because of its strong dependence on North American trade. Simulation results reported in this paper support this conjecture.

4 Benchmark simulation results

Below, I report the results of simulations of the quantitative North American trade model under two trade liberalization scenarios. The first experiment looks at a limited NAFTA in which I maintain NTBs and remove only the explicit tariffs between Canada, Mexico, and the U.S. The second experiment examines the removal of all North American barriers, including tariffs and NTBs.[5]

Welfare analysis I calculate the welfare effects of liberalization by measuring the effect on country k's representative households' lifetime utility U_k. For example, let λ_k^T represent the permanent percentage change in the level of pre-liberalization consumption in country

[5]Note, Kouparitsas (1997) examines the implications of the model used in his paper under a wide array of North American trade liberalization scenarios. In that paper I offer an explanation for why countries do not undertake unilateral trade liberalization, and why nations have apparently abandoned the pursuit of global free-trade in favor of less ambitious regional bilateral free-trade agreements. I argue on the basis of simulation results that trade liberalization takes on the form of a prisoners dilemma. In particular, I show that unilateral trade liberalization makes the liberalizing country worse off, while making its North American trading partners better off. I also show that bilateral agreements, such as, NAFTA and the CFTA make each liberalizing country better off. This suggests that trade liberalization requires enforceable bilateral trade agreements, such as NAFTA and the CFTA.

k that would make households in country k as well off as the path of consumption and leisure enjoyed under trade liberalization $\left\{\tilde{c}_{kt}, \tilde{h}_{kt}\right\}_{t=0}^{\infty}$, that is,

$$\sum_{t=0}^{\infty} \beta^t u(\bar{c}_k(1+\lambda_k^T), \bar{h}_k) \ = \sum_{t=0}^{\infty} \beta^t u(\tilde{c}_{kt}, \tilde{h}_{kt})$$

where, u is the representative household's momentary utility function, and $(\bar{c}_k, \bar{h}_k)$ is country k's representative households respective steady state levels of consumption and leisure in the pre-liberalization environment. In other words, $\bar{c}_k \lambda_k^T$ measures the amount by which you have to change consumption in the pre-liberalized environment to make households as well off as under the liberalized environment. If $\lambda_k^T > 0$, liberalization makes households better off.

I can calculate the steady state welfare implications using a similar measure. In particular, define λ_k^S as the solution to following problem:

$$u(\bar{c}_k(1+\lambda_k^S), \bar{h}_k) = u(\tilde{c}_k, \tilde{h}_k) \tag{23}$$

where $(\tilde{c}_k, \tilde{h}_k)$ is the level of consumption and leisure enjoyed in the liberalized steady state. By calculating λ_k^S I can determine the percentage change in pre-liberalization steady state consumption that would make households in country k indifferent to the liberalized steady state. The transitional cost associated with moving to this steady state, measured as a percent of the initial consumption level, is simply $\lambda_k^S - \lambda_k^T$.

Table 3 describes the longrun effects of trade liberalization on economic activity and welfare. The top three rows of Table 3 report, λ_k^S, $\lambda_k^S - \lambda_k^T$ and λ_k^T. The left panel shows the welfare effects of eliminating explicit tariffs. My estimates are similar to static studies in that the welfare effects from this limited form of liberalization are negligible for Canada and the U.S., and small for Mexico. In the right panel, I calculate the welfare implications of NAFTA (that is, lowering all trade barriers). I find that the welfare effects, in terms of initial consumption levels, are 1.88 percent for Mexico, 0.15 percent for the U.S., -0.04 percent for Canada, and -0.01 percent for the ROW. Based on these results, NAFTA leads to welfare improvements for the Mexico and the U.S., and generates welfare losses for Canada and the ROW. The upper row of the same panel shows that the steady state welfare effects of NAFTA are positive for all regions, with a fairly large welfare effect for Mexico of 3.11 percent. The second row reveals that the transitional costs of liberalizing trade. In the case of Canada and the ROW these costs outweigh the steady state gains.

The calibration of the dynamic model is similar to the calibration of Brown, Deardorff and Stern's (1992) static model. They conduct a similar policy analysis and find that the static welfare gains from NAFTA are close to estimates from my dynamic model, with Mexico gaining by roughly 1.6 percent, and small gains accruing to Canada and the U.S. One explanation for the similarity of the findings is that the static model assumes an instantaneous reduction of trade barriers. I explore this implication in Table 4. The left panel of Table 4 allows for the removal of all trade barriers in January, 1993. The welfare effects associated with this alternative policy are significant, with Mexican and U.S. welfare rising by an additional 0.80 and 0.06 percent, respectively, over the base case reported in Table 3. These results suggests that the dynamic features of the current model generate welfare effects for Mexico and the U.S. that are 50 percent larger than comparable static estimates.

Aggregate effects of trade liberalization The middle panel of Table 3 reveals the aggregate longrun effects of trade liberalization.[6] My simulations suggest that the two liberalization scenarios lead to an expansion of output, investment, consumption, labor hours, and trade in all three North American economies. NAFTA generates an expansion of the North American region, with Mexico enjoying the largest expansion within the region. Under NAFTA Mexico's steady state gross domestic product (GDP) is predicted to rise by 3.64 percent. Underlying this increased output is greater capital accumulation and increased labor effort. This expanded output is also reflected in increased steady state consumption of 3.89 percent and double-digit increases in exports and imports volumes.

[6]My simulation results are not directly comparable to Manchester and McKibbin's (1995) aggregate dynamic study of NAFTA because their experiment assumes that NAFTA exogenously raises the level of Mexican total factor productivity (A_{it}'s in my notation) by 5.5 percent over a period of 11 years.

The model predicts NAFTA will also lead to capital inflows to Mexico. Over the simulation period Mexico's ratio of net foreign assets to GDP falls by 13 percentage points. Looking across the row it is clear that the Mexican capital inflows are largely driven by capital flows from the ROW. NAFTA has a smaller impact on the U.S., with U.S. steady state GDP rising by 0.22 percent. U.S. trade is predicted to rise by around 3.5 percent over its steady state level. Given the small volume of Mexican-Canadian trade, it is not surprising that NAFTA has a negligible impact on the Canadian economy, with steady state output expected to rise by 0.10 percent. According to the model, NAFTA will have a negligible impact on the ROW.

Brown et al. (1992) do not report the aggregate effects of their trade liberalization experiments. Cox and Harris (1992) and Cox (1994) focus on the effects of NAFTA on the Canadian economy. Cox-Harris find as I do that NAFTA has a negligible impact on Canada. Under the assumption of fixed capital stocks and a zero current account, Sobarzo's (1992, 1994) small open economy model of Mexico predicts that NAFTA will raise Mexican steady state GDP by 1.7 percent. This is less than 50 percent of the change predicted by my dynamic model. Overall, the direction of change predicted by the static and dynamic models is the same. However, the predicted size of the impact in static models is generally smaller than the dynamic model. This is because the static models limit the world capital stock to its pre-NAFTA level and rule out international capital flows.

Figures 2–4 plot the aggregate transition paths of the North American economies under the NAFTA policy. In each case it is clear that virtually all of the aggregate adjustment is completed by the time the policy is fully implemented in 2004. These figures also suggest that the announcement of NAFTA, in December 1992, had a significant impact on U.S. and Mexican economic activity well before its implementation date in January, 1994.

Sectoral effects of trade liberalization The lower half of Table 3 describes the longrun effects of NAFTA on sectoral activity. Greater detail on the transition paths of sectoral activity, and disaggregated expenditure and trade flows are reported in Figures 5–7. Model simulations suggest that NAFTA will have a negative impact on the U.S. and Canadian primary sectors, which includes agriculture and mining, with the level of gross output falling by roughly 1 percent in the longrun. In contrast, the model predicts that NAFTA will lead to an expansion of all non-primary activity in the U.S. and Canada, and an expansion of all Mexican sectors. The figures suggest that sectoral accumulation/reallocation of factors will take roughly 10 years.

Sectoral comparisons between my work and the static studies cited above are complicated by the fact that my model is highly aggregated in comparison to static analyses. Specifically, Brown et al.'s (1992) model has 29 sectors, while the models of Cox and Harris (1992), Cox (1994), and Sobarzo (1992, 1994) have 19 sectors. The Cox-Harris and Sobarzo models predict an expansion of all Canadian and Mexican sectors under NAFTA. In contrast, Brown et al. find that all Canadian and U.S. sectors expand under NAFTA, but only a few major industries expand in Mexico. Aggregating their results to the level of the dynamic model I find similar directions of change, but the changes in the dynamic model are typically larger than in the static models.

Model simulations suggest that NAFTA will greatly expand the flow of all goods from Canada and the U.S. to Mexico and from Mexico to the U.S. and Canada. In general, bilateral Mexican-North American trade is predicted to increase by 40-60 percent. In contrast, the model predicts NAFTA will have a negligible impact on bilateral trade flows between the U.S. and Canada and between North America and the ROW. The expansion of North American trade is distributed across all traded goods sectors. Primary and nondurable manufactured goods flows are expected to grow by more than durable manufactured goods flows. For example, Mexican primary and nondurable goods exports rise by roughly 30–40 percent of their pre-NAFTA level, while Mexican durable manufactured goods exports rise by roughly 25 percent of their pre-NAFTA level.

5 Sensitivity analysis

To what extent are the results sensitive to the parameterization of the model? I show that the qualitative features of the results are largely invariant to the choice of model parameters: Mexico and the U.S. gain from liberalization for all reasonable parameterizations. Quantitatively, the model is sensitive to the degree of substitution between home and foreign goods and the speed at which trade liberalization occurs.

Elasticities of substitution The most important parameter in trade liberalization analysis is the elasticity of substitution between home and imported goods. Table 5 reports results from simulations of the model using different elasticities of substitution between home and foreign goods. In the left panel, I report the model's results under the set of elasticities used by Roland-Holst and Reinert (1993) and Sobarzo (1992), which are close to unity or one third of the benchmark elasticities. This is my preferred set of elasticities, since they are consistent with the NTB equivalent tariff measures used in the current analysis. One of the qualitative features of regional free trade agreements is that they impose quality standards on traded goods. This works to raise the degree of substitutability between goods traded in the region. I respond to this in the right panel by raising the elasticity of substitution between home and foreign goods from 3 to 10. Table 5 shows that many of the aggregate features of the model are sensitive to this parameter choice. Lower elasticities of substitution reduce the welfare gains for the U.S. and Mexico by 0.10 and 1.34 percent respectively. Much of this change is driven by the negative terms of trade effects that flow from lower elasticities of substitution. Trade flows are also considerably smaller under this parameterization. In contrast, raising the elasticity of substitution between North American goods raises the welfare gains for all liberalizing countries. Under this scenario, Mexico and the U.S. would gain by an additional 3.5 and 0.3 percent, respectively, over the base case. Trade flows are also considerably higher.

Adjustment costs Table 6 tests the model's sensitivity to sectoral capital and labor adjustment costs. The upper panel shows that the model's aggregate longrun behavior is virtually unchanged in cases where there are no sectoral capital or labor adjustment costs. The sectoral data reported in the lower panel suggests that the adjustment costs have their greatest impact on primary activity, which is expected since that sector has the highest costs of adjustment. In particular, lower sectoral adjustment costs raise the flow of capital and labor into Mexican primary output and out of U.S. and Canadian primary activity.

Domestic elasticities of substitution There are a wide range of estimates for the elasticity substitution between value-added and materials in production. CGE modelers typically assume Leontief or near-Leontief production functions. I find that this approach is supported by empirical studies (see, for example, Ramey 1989), which suggest that the elasticity of substitution between these factors is close to zero. Other dynamic models such as Ho and Jorgenson (1994, 1998) and McKibbin (1998) utilize Cobb-Douglas production functions, with a unit elasticity of substitution. I test the model's sensitivity to this parameter choice in the left panel of Table 7. The longrun behavior of the model appears to be largely invariant to this parameter choice. I conduct a similar experiment in the right panel, but now move in the reverse direction by lowering the elasticity of substitution across different types of consumer nondurables and investment goods from unity to 0.1, so that these aggregation functions are near-Leontief. Again, the results are largely invariant to this parameter specification.

Trade policies. The final set of experiments, and the most interesting from a policy perspective, consider different speeds of trade liberalization. In the previous section I discussed the welfare implications of a static policy in which all barriers are removed at the time the NAFTA agreement is signed. I now turn attention to a feature of NAFTA that was a key element of the U.S. policy debate. Sensitive U.S. sectors, such as the agriculture and automobile production industry, argued that trade liberalization would have a smaller impact on their sectors if it was phased in over 15 years, rather than 10 years. In response to this NAFTA allows for a slower reduction of trade barriers on agricultural and automotive imports. The right panel of Table 4 measures the aggregate and sectoral implications of phasing in NAFTA over a 15 year period. The welfare cost of pursuing this policy is 0.24 percent of pre-NAFTA Mexican consumption, and 0.02 percent of pre-NAFTA U.S. consumption. The lower panel of Table 7 suggest that the longrun sectoral effects are largely invariant to policy choice.

Figures 8–10 plot the aggregate transition paths of three policies: the benchmark NAFTA policy, implemented in January 1994 and phased in over 10 years (solid line); the static policy, discussed in the previous section, in which there is a 100 percent liberalization in January 1993 (solid-dashed line); and the 15 year policy just described (dashed line). It is clear from these figures that the 10 and 15 year paths of adjustment are very similar. The most significant difference is that adjustment to the 15 year policy is completed after 15 rather than 10 years. The differences between the 10 year and static policies are more dramatic. The obvious difference is the impact effect of the policies: output, labor hours, investment, trade flows and the terms of trade all move along way toward their longrun position under the static policy in the first year of liberalization. Another feature of these figures is that the consumption paths for the U.S. and Mexico are significantly higher over the first 10 years of the simulations under the static policy. This is clearly evident in the welfare calculations of Table 4 which reveal the significant gains that flow from more rapid liberalization.

6 Conclusion

NAFTA is a landmark commercial trade policy because it is the first far-reaching free trade agreement between major industrial countries and a developing country. Simulations from my dynamic model, under a wide set of parameters, suggest that the steady state gains from trade liberalization are significant for all three North American countries. At the same time my analysis implies that the transitional costs of moving to NAFTA are nontrivial.

On balance the dynamic analysis suggests that Canada will experiences a small welfare loss from liberalization, while the U.S. and Mexico will enjoy modest welfare gains, with the greatest gains accruing to Mexico. The dynamic analysis also suggests NAFTA generates real output and trade flow increases that are larger than those predicted by previous analysis which relied on static trade models. My sectoral analysis implies that NAFTA will lead to an expansion of all non-primary sectors in Canada, Mexico, and the U.S. In contrast, NAFTA is expected to have a negative impact on the real output of Canadian and U.S. primary sectors, but is expected to lead to a sizable expansion of primary activity in Mexico.

This paper has taken the study of multilateral trade liberalization one step further by building a quantitative dynamic multisector trade model of trade, which overcomes many of the weaknesses inherent in traditional multisector static analysis, such as fixed capital stocks and zero current accounts.[7] There are two significant limitations on the current analysis that future work must address. First, the underlying growth rate of the dynamic model economy is exogenous and cannot be influenced by policy. Second, NTBs are incorporated into the numerical analysis by way of tariff equivalent NTBs. Future work must remove these limitations by developing dynamic trade models that allow for endogenous growth and explicit quantity constraints. Only then will we be in a position to measure the true gains from multilateral free trade agreements.

[7]See Kehoe (1994) for a thorough discussion of the limitations to current static analyses and the steps needed to develop a state of the art dynamic model suitable for analyzing free trade agreements.

References

[1] Backus, D.K., P.J. Kehoe and F.E. Kydland, 1995, International business cycles: Theory and evidence, in: T.F. Cooley, ed., Frontiers of business cycle research (Princeton University Press, Princeton, NJ).

[2] Baxter, M., 1992, Fiscal policy, specialization and trade in the two sector model: The return of Ricardo?, Journal of Political Economy 100, 713–744.

[3] Baxter, M., 1995, International trade and business cycles, in: G.M. Grossman and K. Rogoff, eds., Handbook of international economics, Volume III (North Holland, Amsterdam).

[4] Baxter, M., and M.J. Crucini, 1993, Explaining saving-investment correlations, American Economic Review 83, 416–436.

[5] Baxter, M., and M.J. Crucini, 1995, Business cycles and the asset structure of foreign trade, International Economic Review 36, 821–854.

[6] Brown, D.K., A.V. Deardorff, and R.M., Stern, 1992, A North American Free Trade Agreement: Analytical issues and a computational assessment, The World Economy 15, 11–30.

[7] Cox, D.J., and R.G. Harris, 1992, North American free trade and its implications for Canada: Results from a CGE Model of North American trade, The World Economy 15, 31–44.

[8] Cox, D.J., 1994, Some applied general equilibrium estimates of the impact of the North American Free Trade Agreement on Canada: J.F. Francois and C.R. Shiells, eds., Modeling trade policy: Applied general equilibrium assessments of North American free trade (Cambridge University Press, Cambridge, UK).

[9] Francois, J.F., and C.R. Shiells, 1994, Modeling trade policy: Applied general equilibrium assessments of North American free trade (Cambridge University Press, Cambridge, UK).

[10] Goulder, L.H., and B. Eichengreen, 1992, Trade liberalization in general equilibrium: intertemporal and inter-industry effects, Canadian Journal of Economics 25, 253–280.

[11] Greenway, D., and J.B. Whalley, 1992, The World Economy Vol 15 (Blackwell, Oxford, UK).

[12] Ho, M.S., and D.W. Jorgenson, 1994, Trade policy and U.S. economic growth, Journal of Policy Modelling 16, 119–146.

[13] Ho, M.S., and D.W. Jorgenson, 1998, Modeling trade policies and U.S. growth: some methodological issues, Harvard University working paper.

[14] Kehoe, P.J., and T.J. Kehoe, 1994, Capturing NAFTA's impact with applied general equilibrium models, Federal Reserve Bank of Minneapolis Quarterly Review Spring, 17–33.

[15] Kehoe, T.J., 1994, Toward a dynamic general equilibrium model of North American trade in: J.F. Francois and C.R. Shiells, eds., Modeling trade policy: Applied general equilibrium assessments of North American free trade (Cambridge University Press, Cambridge, UK).

[16] King, R.G., C.I. Plosser, and S.T. Rebelo, 1988, Production, growth and business cycles I: The basic neoclassical model, Journal of Monetary Economics 21, 195–232.

[17] King, R.G., C.I. Plosser, and S.T. Rebelo, 1990, Production, growth and business cycles: Technical appendix, Manuscript (University of Rochester, Rochester, NY).

[18] Kouparitsas, M.A., 1996, North-South business cycles, Federal Reserve Bank of Chicago Working Paper 96–9 (Federal Reserve Bank of Chicago, Chicago, IL).

[19] Kouparitsas, M.A., 1997, Why do countries pursue bilateral trade agreements? A case study of North America (previously titled: Would free trade have emerged in North America without NAFTA?), Federal Reserve Bank of Chicago Working Paper 97–20 (Federal Reserve Bank of Chicago, Chicago, IL).

[20] Lustig, N., B.P., Bosworth, and R.Z. Lawerence, 1992, North American free trade: Assessing the impact (The Brookings Institution, Washington, D.C.).

[21] Manchester, J., and W.J. McKibbin, 1995, The global macroeconomics of NAFTA, Open Economies Review 6, 203–223.

[22] McKibbin, W.J., 1998, Regional and multilateral trade liberalization: the effects on trade, investment and welfare, Australian National University working paper.

[23] McKibbin, W.J., and P.J. Wilcoxen, 1995, The theoretical and empirical structure of the G-cubed model, Australian National University working paper..

[24] Ramey, V.A., 1989, Inventories as factors of production and economic fluctuations, American Economic Review 79, 338–354.

[25] Roland-Holst, D.W., K.A. Reinert, and C.R. Shiells, 1992, North American trade liberalization and the role of nontariff barriers in: U.S. International Trade Commission, Economy-wide modeling of the economic implications of a FTA with Mexico and a NAFTA with Canada and Mexico, USTIC Publication 2508, 523–580.

[26] Roland-Holst, D.W., K.A. Reinert, and C.R. Shiells, 1994, A general equilibrium analysis of North American economic integration in: J.F. Francois and C.R. Shiells, eds., Modeling trade policy: Applied general equilibrium assessments of North American free trade (Cambridge University Press, Cambridge, UK).

[27] Sato, K., 1969, A two-level constant-elasticity-of-substitution production function, Review of Economic Studies 34, 201–218.

[28] Sobarzo, H.E., 1992, A general equilibrium analysis of the gains for Mexico from a North American Free Trade Agreement, The World Economy 15, 83–100.

[29] Sobarzo, H.E., 1994, The gains for Mexico from a North American Free trade Agreement: An applied general equilibrium assessment in: J.F. Francois and C.R. Shiells, eds., Modeling trade policy: Applied general equilibrium assessments of North American free trade (Cambridge University Press, Cambridge, UK).

[30] Shiells, C.R., and K.A. Reinert, 1993, Armington models and terms-of-trade effects: Some econometric evidence for North America, Canadian Journal of Economics 26, 299–316.

[31] Shoven, J.B., and J. Whalley, 1992, Applying general equilibrium, (Cambridge University Press, Cambridge, UK).

Table 1					
Benchmark model parameters					
	Canada	**Mexico**	**US**	**ROW**	**All**
Preferences					
β					0.98
σ					2.00
N					0.20
θ_c	0.23	0.29	0.21	0.20	
$1/\eta$					1.00
ω_c consistent with expenditure share:					0.81
$1/\kappa$					1.00
ω_{c1} consistent with expenditure share:	0.01	0.08	0.01	0.01	
ω_{c2} consistent with expenditure share:	0.17	0.24	0.17	0.17	
ω_{c5} consistent with expenditure share:	0.82	0.68	0.82	0.82	
$(\phi_d''/\phi_d')/(i_d/d)$					-10.00
Investment					
δ					0.025
$1/\upsilon$					1.00
ω_{i3} consistent with expenditure share:	0.52	0.41	0.52	0.52	
ω_{i4} consistent with expenditure share:	0.39	0.47	0.39	0.39	
ω_{i5} consistent with expenditure share:	0.09	0.12	0.09	0.09	
$(\phi_k''/\phi_k')/(i_k/k)$					-10.00
Production					
$1/\varepsilon$					0.10
Primary Sector					
θ_1	0.31	0.27	0.31	0.31	
α_1	0.35	0.35	0.35	0.35	
ω_{y1} consistent with cost share:	0.51	0.71	0.48	0.48	
α_{11} consistent with cost share:	0.23	0.31	0.40	0.40	
α_{12} consistent with cost share:	0.19	0.34	0.16	0.16	
α_{13} consistent with cost share:	0.06	0.13	0.05	0.05	
α_{14} consistent with cost share:	0.02	0.00	0.02	0.02	
α_{15} consistent with cost share:	0.49	0.21	0.37	0.37	
$(\phi_{k1}''/\phi_{k1}')/(k_1/k)$					-1.50
$(\phi_{N1}''/\phi_{N1}')/(N_1/N)$					-0.02
Non-Durable Manufacturing Sector					
θ_2	0.57	0.37	0.52	0.52	
α_2	0.43	0.63	0.48	0.48	
ω_{y2} consistent with cost share:	0.36	0.39	0.39	0.39	
α_{21} consistent with cost share:	0.26	0.37	0.23	0.23	
α_{22} consistent with cost share:	0.42	0.40	0.45	0.45	
α_{23} consistent with cost share:	0.05	0.04	0.06	0.06	
α_{24} consistent with cost share:	0.01	0.00	0.01	0.01	
α_{25} consistent with cost share:	0.26	0.19	0.25	0.25	
$(\phi_{k2}''/\phi_{k2}')/(k_2/k)$					-10.00
$(\phi_{N2}''/\phi_{N2}')/(N_2/N)$					-10,000
Durable Manufacturing Sector					
θ_3	0.68	0.43	0.68	0.68	
α_3	0.32	0.57	0.32	0.32	
ω_{y3} consistent with cost share:	0.36	0.43	0.43	0.43	
α_{31} consistent with cost share:	0.12	0.11	0.03	0.03	
α_{32} consistent with cost share:	0.06	0.10	0.10	0.10	

Table 1 (cont.)					
Benchmark model parameters					
	Canada	**Mexico**	**US**	**ROW**	**All**
α_{33} consistent with cost share:	0.59	0.51	0.57	0.57	
α_{34} consistent with cost share:	0.00	0.00	0.01	0.01	
α_{35} consistent with cost share:	0.22	0.28	0.29	0.29	
$(\phi_{k3}''/\phi_{k3}')/(k_3/k)$					-10.00
$(\phi_{N3}''/\phi_{N3}')/(N_3/N)$					-10,000
Construction Sector					
θ_4	0.73	0.70	0.66	0.66	
α_4	0.27	0.30	0.34	0.34	
ω_{y4} consistent with cost share:	0.47	0.50	0.47	0.47	
α_{41} consistent with cost share:	0.07	0.03	0.02	0.02	
α_{42} consistent with cost share:	0.10	0.09	0.08	0.08	
α_{43} consistent with cost share:	0.47	0.59	0.47	0.47	
α_{44} consistent with cost share:	0.00	0.00	0.00	0.00	
α_{45} consistent with cost share:	0.35	0.29	0.42	0.42	
$(\phi_{k4}''/\phi_{k4}')/(k_4/k)$					-10.00
$(\phi_{N4}''/\phi_{N4}')/(N_4/N)$					-10,000
Services Sector					
θ_5	0.52	0.40	0.67	0.67	
α_5	0.48	0.60	0.33	0.33	
ω_{y5} consistent with cost share:	0.62	0.80	0.66	0.66	
α_{51} consistent with cost share:	0.02	0.01	0.03	0.03	
α_{52} consistent with cost share:	0.15	0.18	0.12	0.12	
α_{53} consistent with cost share:	0.07	0.11	0.06	0.06	
α_{54} consistent with cost share:	0.04	0.08	0.06	0.06	
α_{55} consistent with cost share:	0.72	0.62	0.73	0.73	
$(\phi_{k5}''/\phi_{k5}')/(k_5/k)$					-10.00
$(\phi_{N5}''/\phi_{N5}')/(N_5/N)$					-10,000
Trade					
Primary					
$1/\mu_1$					3.00
ω_{1can} consistent with expenditure share:	0.77	0.00	0.04	0.02	
ω_{1mex} consistent with expenditure share:	0.01	0.88	0.04	0.02	
ω_{1usa} consistent with expenditure share:	0.13	0.06	0.80	0.07	
ω_{1row} consistent with expenditure share:	0.09	0.06	0.12	0.90	
Non-Durable Manufacturing					
$1/\mu_2$					3.00
ω_{2can} consistent with expenditure share:	0.80	0.00	0.02	0.00	
ω_{2mex} consistent with expenditure share:	0.00	0.87	0.01	0.00	
ω_{2usa} consistent with expenditure share:	0.14	0.08	0.90	0.03	
ω_{2row} consistent with expenditure share:	0.05	0.05	0.07	0.97	
Durable Manufacturing					
$1/\mu_3$					3.00
ω_{3can} consistent with expenditure share:	0.50	0.01	0.06	0.01	
ω_{3mex} consistent with expenditure share:	0.01	0.61	0.02	0.00	
ω_{3usa} consistent with expenditure share:	0.36	0.24	0.75	0.07	
ω_{3row} consistent with expenditure share:	0.13	0.14	0.17	0.92	

Table 2

Levels of protection in North America prior to implementation of CFTA and NAFTA

Tariff rates

Primary products

Importer	Exporter: Canada	Mexico	U.S.	ROW
Canada		0.01	0.01	0.00
Mexico	0.00		0.02	0.00
U.S.	0.01	0.01		0.01

Non-durable manufactured goods

Importer	Exporter: Canada	Mexico	U.S.	ROW
Canada		0.18	0.07	0.14
Mexico	0.04		0.05	0.10
U.S.	0.04	0.05		0.10

Durable manufactured goods

Importer	Exporter: Canada	Mexico	U.S.	ROW
Canada		0.04	0.02	0.04
Mexico	0.01		0.03	0.02
U.S.	0.01	0.03		0.03

Composite protection rates (tariffs and NTBs)

Primary products

Importer	Exporter: Canada	Mexico	U.S.	ROW
Canada		0.20	0.61	0.27
Mexico	0.80		0.81	0.72
U.S.	0.61	0.88		0.77

Non-durable manufactured goods

Importer	Exporter: Canada	Mexico	U.S.	ROW
Canada		0.68	0.34	0.44
Mexico	0.78		0.41	0.47
U.S.	0.16	0.22		0.20

Durable manufactured goods

Importer	Exporter: Canada	Mexico	U.S.	ROW
Canada		0.25	0.26	0.31
Mexico	0.01		0.13	0.22
U.S.	0.39	0.07		0.28

Notes: Roland-Holst et al. (1994) report estimates for 26 sectors. Sectoral aggregates reported in this article are weighted by 1992 import shares. ROW is rest of the world.

Source: Roland-Holst, Reinert and Shiells (1994)

Table 3

Long-run effects of competing North American trade liberalization schemes
(percentage deviation from pre-NAFTA steady state)

	Tariffs only				Tariffs and Non-Tariff Barriers			
Variable	**Canada**	**Mexico**	**USA**	**ROW**	**Canada**	**Mexico**	**USA**	**ROW**
Welfare effects								
Steady state gain	0.03	0.43	0.04	0.01	0.13	3.11	0.29	0.06
Transitional cost	0.03	0.20	0.03	0.01	0.17	1.24	0.15	0.07
Net effect	-0.00	0.23	0.02	-0.01	-0.04	1.88	0.15	-0.01
Aggregate effects								
Real GDP	0.01	0.91	0.03	-0.00	0.10	3.64	0.22	-0.03
Real consumption	0.03	0.68	0.05	0.00	0.17	3.89	0.38	0.04
Labor hours	-0.00	0.40	0.01	-0.00	0.05	1.27	0.09	-0.02
Real wage	0.03	0.77	0.05	0.00	0.18	4.21	0.40	0.03
Capital stock	0.02	1.38	0.07	-0.00	0.16	5.79	0.46	-0.04
Real rental rate	-0.01	-0.35	-0.03	-0.00	0.01	-1.56	-0.00	0.04
Total imports	0.12	4.42	0.57	0.00	0.62	26.04	3.49	0.21
Exports to World	0.10	5.70	0.56	-0.10	0.62	30.85	3.85	-0.84
to Canada		14.14	-0.14	-0.15		63.81	-0.40	-0.79
to Mexico	3.78		7.22	-0.23	23.73		43.24	-3.32
to US	0.05	7.66		-0.08	0.18	45.20		-0.69
to ROW	0.12	-0.58	0.02		1.09	-11.06	0.66	
Terms of trade	-0.04	0.03	0.00	0.00	-0.28	0.74	-0.13	0.13
Net foreign assets/GDP	0.19	-3.18	0.00	0.13	0.97	-13.45	-0.35	0.74
Sectoral effects								
Primary								
Output	0.01	0.57	0.01	-0.00	-0.55	4.03	-0.99	-0.39
Labor hours	-0.00	0.39	0.00	-0.00	-0.01	1.41	-0.01	-0.06
Capital stock	0.03	1.29	0.02	-0.01	-1.34	9.73	-2.52	-0.94
Exports	0.04	0.34	0.35	-0.07	-1.39	32.89	10.73	-6.57
Nondurable mfg.								
Output	-0.06	1.41	-0.00	-0.01	0.09	2.05	0.91	-0.03
Labor hours	-0.07	0.77	-0.04	-0.01	-0.05	-0.96	0.63	-0.06
Capital stock	-0.04	1.76	0.03	-0.01	0.18	3.71	1.02	-0.04
Exports	0.11	10.56	0.60	-0.08	0.94	41.21	7.40	-1.07
Durable mfg.								
Output	0.04	1.86	0.07	-0.02	0.54	6.59	0.36	-0.03
Labor hours	0.03	1.29	0.05	-0.02	0.45	4.06	0.20	-0.04
Capital stock	0.06	2.24	0.12	-0.02	0.64	8.28	0.62	-0.02
Exports	0.11	7.72	-0.13	-0.14	0.90	26.19	-0.77	-0.53
Construction								
Output	0.01	0.98	0.04	-0.00	0.10	4.35	0.26	-0.02
Labor hours	0.01	0.64	0.01	-0.00	0.03	2.88	0.09	-0.03
Capital stock	0.03	1.65	0.08	-0.00	0.25	7.21	0.53	-0.01
Exports								
Services								
Output	0.01	0.68	0.03	-0.00	0.08	3.21	0.17	-0.01
Labor hours	0.00	0.05	0.00	-0.00	-0.04	0.48	0.01	-0.02
Capital stock	0.03	1.11	0.08	-0.00	0.19	5.03	0.45	-0.00
Exports								

Table 4

Long-run effects of NAFTA under different parameters (trade policies)

(deviation from benchmark model expressed as a percentage of pre-NAFTA steady state)

	100% liberalization Jan 1993				15 year liberalization			
Variable	**Canada**	**Mexico**	**USA**	**ROW**	**Canada**	**Mexico**	**USA**	**ROW**
Welfare effects								
Steady state gain	-0.11	0.70	0.05	-0.04	0.03	-0.22	-0.01	0.01
Transitional cost	-0.09	-0.10	-0.02	-0.04	0.03	0.02	0.00	0.01
Net effect	-0.02	0.80	0.06	-0.00	0.01	-0.24	-0.02	0.00
Aggregate effects								
Real GDP	0.02	-0.14	-0.02	0.02	-0.01	0.03	0.00	-0.01
Real consumption	-0.06	0.47	0.02	-0.02	0.02	-0.16	-0.01	0.00
Labor hours	0.05	-0.38	-0.03	0.02	-0.01	0.12	0.01	-0.01
Real wage	-0.05	0.37	0.02	-0.01	0.01	-0.13	-0.01	0.00
Capital stock	-0.02	0.05	-0.00	0.01	0.00	-0.03	-0.00	-0.00
Real rental rate	0.03	-0.11	-0.01	0.00	-0.01	0.04	0.01	-0.00
Total imports	-0.10	1.20	0.12	-0.30	0.03	-0.35	-0.04	0.09
Exports to World	0.15	-1.42	-0.16	0.34	-0.04	0.42	0.05	-0.10
to Canada		-1.66	-0.17	0.17		0.49	0.05	-0.05
to Mexico	1.30		1.07	1.41	-0.38		-0.31	-0.42
to US	0.20	-1.56		0.29	-0.06	0.46		-0.09
to ROW	-0.04	-1.04	-0.29		0.01	0.31	0.09	
Terms of trade	-0.06	0.49	0.06	-0.12	0.02	-0.14	-0.02	0.04
Net foreign assets/GDP	-0.68	5.15	0.34	-0.38	0.19	-1.57	-0.10	0.12
Sectoral effects								
Primary								
Output	0.05	-0.24	-0.02	0.05	-0.02	0.07	0.00	-0.01
Labor hours	0.06	-0.39	-0.03	0.03	-0.02	0.12	0.01	-0.01
Capital stock	0.08	-0.37	-0.02	0.09	-0.03	0.09	0.00	-0.03
Exports	0.01	-0.75	-0.04	0.15	-0.00	0.23	0.01	-0.05
Nondurable mfg.								
Output	0.07	-0.20	-0.03	0.03	-0.02	0.05	0.01	-0.01
Labor hours	0.10	-0.53	-0.05	0.04	-0.03	0.16	0.01	-0.01
Capital stock	0.03	-0.04	-0.02	0.02	-0.01	-0.01	0.00	-0.01
Exports	0.20	-1.72	-0.16	0.37	-0.06	0.51	0.05	-0.11
Durable mfg.								
Output	0.14	-1.04	-0.09	0.08	-0.04	0.31	0.03	-0.02
Labor hours	0.17	-1.38	-0.11	0.09	-0.05	0.42	0.03	-0.03
Capital stock	0.08	-0.81	-0.07	0.06	-0.03	0.23	0.02	-0.02
Exports	0.16	-1.76	-0.15	0.22	-0.05	0.52	0.05	-0.07
Construction								
Output	-0.01	0.01	-0.00	0.01	0.00	0.00	0.00	-0.00
Labor hours	0.01	-0.15	-0.01	0.01	-0.00	0.06	0.01	-0.00
Capital stock	-0.06	0.30	0.01	-0.00	0.01	-0.10	-0.01	0.00
Exports								
Services								
Output	-0.01	0.09	0.00	0.00	0.00	-0.04	-0.00	-0.00
Labor hours	0.02	-0.19	-0.01	0.01	-0.01	0.06	0.00	-0.00
Capital stock	-0.05	0.27	0.02	-0.01	0.01	-0.10	-0.01	0.00
Exports								

Table 5

Long-run effects of NAFTA under different parameters (trade elasticities)

(deviation from benchmark model expressed as a percentage of pre-NAFTA steady state)

	Low elasticity of substitution				High elasticity of substitution			
Variable	**Canada**	**Mexico**	**USA**	**ROW**	**Canada**	**Mexico**	**USA**	**ROW**
Welfare effects								
Steady state gain	-0.04	-1.06	-0.11	-0.02	0.05	2.79	0.32	0.11
Transitional cost	-0.04	0.27	-0.01	-0.04	0.02	-0.65	0.01	0.11
Net effect	0.01	-1.34	-0.10	0.02	0.03	3.44	0.32	-0.00
Aggregate effects								
Real GDP	0.02	-0.35	0.02	0.04	0.14	-1.80	-0.14	-0.04
Real consumption	-0.03	-0.95	-0.08	-0.01	0.15	1.44	0.18	0.09
Labor hours	0.01	0.19	0.03	0.02	0.12	-2.20	-0.15	-0.02
Real wage	-0.03	-0.90	-0.07	-0.00	0.19	0.89	0.14	0.09
Capital stock	0.04	-0.81	0.00	0.07	0.13	-1.58	-0.11	-0.09
Real rental rate	-0.04	0.33	-0.03	-0.04	0.07	-0.02	0.11	0.12
Total imports	-0.24	-15.61	-2.04	0.13	0.89	53.50	6.97	-0.51
Exports to World	-0.22	-18.39	-2.24	0.73	1.24	60.44	7.71	-2.42
to Canada		-40.59	0.47	0.51		137.57	-1.65	-1.42
to Mexico	-14.05		-26.96	3.76	48.45		93.00	-13.98
to US	0.10	-28.03		0.56	0.06	93.47		-1.78
to ROW	-0.66	9.77	-0.25		3.03	-36.21	0.85	
Terms of trade	0.13	-1.74	-0.01	0.22	-0.26	0.34	-0.02	0.08
Net foreign assets/GDP	-0.55	10.96	0.33	-0.64	-0.32	-17.63	-1.10	1.43
Sectoral effects								
Primary								
Output	0.52	-0.22	0.80	0.31	-1.51	-2.00	-1.77	-1.29
Labor hours	0.05	0.19	0.10	0.04	-0.01	-2.28	-0.29	-0.12
Capital stock	1.25	-0.74	1.90	0.74	-3.71	-3.78	-4.18	-3.13
Exports	1.13	-19.07	-7.71	5.08	-3.47	63.87	30.36	-20.50
Nondurable mfg.								
Output	0.08	1.51	-0.27	0.05	-0.21	-8.20	0.73	0.00
Labor hours	0.13	2.35	-0.22	0.05	-0.42	-9.34	0.64	-0.07
Capital stock	0.08	1.05	-0.27	0.07	-0.09	-7.68	0.69	-0.03
Exports	-0.40	-25.53	-4.63	0.88	1.35	87.03	15.91	-2.83
Durable mfg.								
Output	-0.24	-1.17	0.11	0.03	1.59	-2.49	-0.76	0.11
Labor hours	-0.21	-0.53	0.15	0.03	1.50	-3.17	-0.83	0.09
Capital stock	-0.24	-1.58	0.06	0.05	1.65	-2.07	-0.65	0.12
Exports	-0.42	-15.66	0.75	0.28	2.12	49.65	-2.83	-0.42
Construction								
Output	0.02	-0.56	0.01	0.04	0.07	-1.28	-0.07	-0.04
Labor hours	0.04	-0.20	0.04	0.03	-0.04	-1.62	-0.13	-0.07
Capital stock	-0.01	-1.27	-0.04	0.05	0.26	-0.67	-0.01	-0.03
Exports								
Services								
Output	0.01	-0.55	0.00	0.02	0.05	-0.41	-0.04	-0.01
Labor hours	0.04	0.11	0.03	0.01	-0.11	-0.95	-0.09	-0.03
Capital stock	-0.01	-0.99	-0.04	0.04	0.19	-0.06	0.02	0.00
Exports								

Table 6

Long-run effects of NAFTA under different parameters (sectoral adjustment costs)

(deviation from benchmark model expressed as a percentage of pre-NAFTA steady state)

	No sectoral capital adj costs				No sectoral labor adj costs			
Variable	**Canada**	**Mexico**	**USA**	**ROW**	**Canada**	**Mexico**	**USA**	**ROW**
Welfare effects								
Steady state gain	0.01	-0.06	0.01	-0.00	0.02	-0.13	0.01	-0.00
Transitional cost	0.00	-0.06	0.00	0.00	0.01	-0.13	0.01	-0.00
Net effect	0.01	-0.00	0.00	-0.00	0.01	-0.00	0.01	-0.00
Aggregate effects								
Real GDP	-0.02	0.08	-0.01	-0.00	-0.04	0.01	-0.03	-0.01
Real consumption	-0.01	-0.03	-0.01	-0.01	-0.02	-0.09	-0.01	-0.01
Labor hours	-0.02	0.05	-0.01	-0.01	-0.04	0.07	-0.03	-0.01
Real wage	-0.01	-0.01	-0.01	-0.01	-0.02	-0.07	-0.02	-0.02
Capital stock	-0.03	0.11	-0.01	-0.00	-0.04	-0.03	-0.03	0.00
Real rental rate	-0.01	-0.06	-0.02	-0.02	-0.02	0.02	-0.03	-0.03
Total imports	-0.02	0.15	-0.00	-0.01	-0.04	0.32	-0.01	-0.03
Exports to World	-0.08	0.53	-0.04	-0.01	-0.14	0.74	-0.08	0.01
to Canada		0.16	-0.02	-0.01		-0.04	-0.04	-0.01
to Mexico	0.11		0.18	0.11	0.25		0.36	0.24
to US	-0.06	0.17		-0.01	-0.10	0.00		-0.01
to ROW	-0.14	1.51	-0.07		-0.25	2.78	-0.15	
Terms of trade	0.04	-0.09	0.02	-0.02	0.07	-0.09	0.03	-0.04
Net foreign assets/GDP	0.07	-0.70	0.03	0.01	0.08	-0.82	0.06	-0.00
Sectoral effects								
Primary								
Output	-0.12	1.04	-0.50	-0.04	-0.18	1.90	-1.01	-0.03
Labor hours	-0.01	0.06	-0.00	0.00	-1.46	6.69	-4.09	-0.72
Capital stock	-0.43	2.97	-1.54	-0.16	0.61	0.30	0.50	0.47
Exports	-0.18	2.19	-0.90	0.25	-0.28	4.05	-1.85	0.60
Nondurable mfg.								
Output	-0.07	-0.01	-0.04	-0.03	-0.10	0.03	-0.11	-0.05
Labor hours	-0.06	0.20	-0.08	-0.03	-0.04	-0.29	-0.06	-0.03
Capital stock	-0.05	-0.17	0.03	-0.02	-0.13	0.16	-0.12	-0.04
Exports	-0.09	-0.32	0.00	-0.03	-0.11	-0.34	-0.08	-0.02
Durable mfg.								
Output	-0.07	-0.09	0.03	-0.01	-0.13	-0.68	0.07	-0.02
Labor hours	-0.08	-0.14	0.01	-0.01	-0.09	-0.99	0.10	-0.01
Capital stock	-0.03	-0.06	0.07	-0.00	-0.17	-0.47	0.02	-0.03
Exports	-0.06	-0.29	0.02	-0.04	-0.12	-1.10	0.06	-0.08
Construction								
Output	-0.02	0.07	-0.00	-0.00	-0.02	-0.15	-0.01	-0.00
Labor hours	-0.02	0.08	-0.02	-0.00	0.01	-0.31	0.02	0.01
Capital stock	-0.00	0.05	0.03	0.01	-0.08	0.15	-0.05	-0.01
Exports								
Services								
Output	-0.00	-0.08	0.00	0.00	-0.00	-0.22	0.00	0.00
Labor hours	-0.00	0.07	-0.01	-0.00	0.04	-0.50	0.03	0.01
Capital stock	0.00	-0.17	0.03	0.01	-0.05	-0.03	-0.04	-0.01
Exports								

Table 7

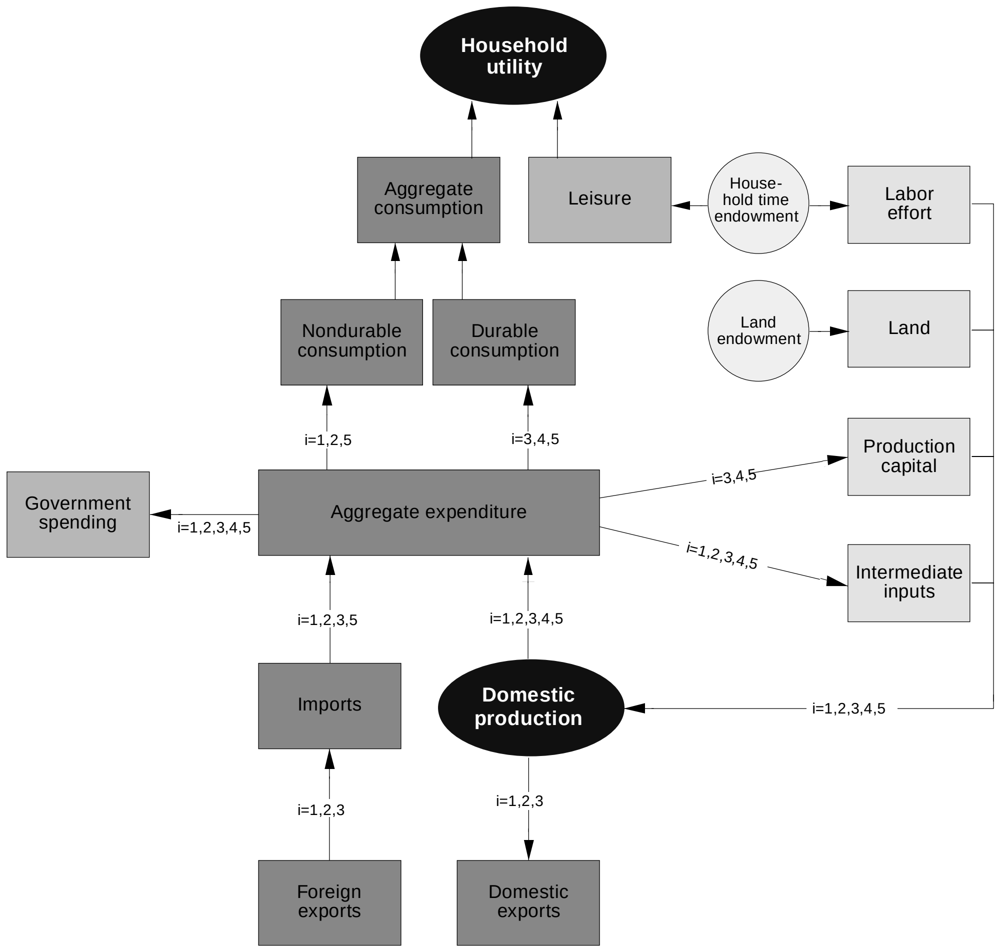
Long-run effects of NAFTA under different parameters (domestic elasticities)

(deviation from benchmark model expressed as a percentage of pre-NAFTA steady state)

	Cobb Douglas production				Near leontief preferences			
Variable	**Canada**	**Mexico**	**USA**	**ROW**	**Canada**	**Mexico**	**USA**	**ROW**
Welfare effects								
Steady state gain	0.04	-0.08	0.03	-0.01	0.04	-0.08	0.03	-0.01
Transitional cost	0.01	-0.06	0.01	-0.01	0.01	-0.06	0.01	-0.01
Net effect	0.04	-0.02	0.02	-0.00	0.04	-0.02	0.02	-0.00
Aggregate effects								
Real GDP	-0.05	0.05	-0.08	-0.00	-0.05	0.05	-0.08	-0.00
Real consumption	-0.01	-0.09	-0.05	-0.02	-0.01	-0.09	-0.05	-0.02
Labor hours	-0.07	-0.02	-0.08	-0.01	-0.07	-0.02	-0.08	-0.01
Real wage	-0.03	-0.10	-0.06	-0.02	-0.03	-0.10	-0.06	-0.02
Capital stock	-0.03	0.10	-0.10	0.01	-0.03	0.10	-0.10	0.01
Real rental rate	-0.04	0.02	-0.04	-0.04	-0.04	0.02	-0.04	-0.04
Total imports	0.10	1.12	0.24	0.05	0.10	1.12	0.24	0.05
Exports to World	-0.02	1.71	0.10	0.17	-0.02	1.71	0.10	0.17
to Canada		1.09	0.12	0.03		1.09	0.12	0.03
to Mexico	0.96		1.23	0.96	0.96		1.23	0.96
to US	0.05	1.47		0.14	0.05	1.47		0.14
to ROW	-0.26	2.42	-0.03		-0.26	2.42	-0.03	
Terms of trade	0.13	-0.24	0.02	-0.03	0.13	-0.24	0.02	-0.03
Net foreign assets/GDP	-0.03	-0.84	0.19	-0.06	-0.03	-0.84	0.19	-0.06
Sectoral effects								
Primary								
Output	0.38	2.03	0.75	0.24	0.38	2.03	0.75	0.24
Labor hours	-0.02	-0.03	-0.01	0.01	-0.02	-0.03	-0.01	0.01
Capital stock	1.19	-0.10	1.90	0.77	1.19	-0.10	1.90	0.77
Exports	0.85	4.18	-2.22	2.91	0.85	4.18	-2.22	2.91
Nondurable mfg.								
Output	0.01	1.94	0.14	-0.04	0.01	1.94	0.14	-0.04
Labor hours	-0.10	1.62	-0.37	-0.05	-0.10	1.62	-0.37	-0.05
Capital stock	-0.14	1.39	-0.41	-0.05	-0.14	1.39	-0.41	-0.05
Exports	-0.03	0.80	0.15	0.13	-0.03	0.80	0.15	0.13
Durable mfg.								
Output	-0.19	1.43	0.22	-0.04	-0.19	1.43	0.22	-0.04
Labor hours	-0.29	0.38	0.05	-0.04	-0.29	0.38	0.05	-0.04
Capital stock	-0.31	0.27	-0.03	-0.04	-0.31	0.27	-0.03	-0.04
Exports	-0.18	0.36	0.20	-0.15	-0.18	0.36	0.20	-0.15
Construction								
Output	-0.02	0.13	-0.03	0.00	-0.02	0.13	-0.03	0.00
Labor hours	-0.09	-1.49	-0.17	-0.00	-0.09	-1.49	-0.17	-0.00
Capital stock	-0.13	-1.44	-0.22	-0.01	-0.13	-1.44	-0.22	-0.01
Exports								
Services								
Output	0.00	0.21	-0.01	-0.00	0.00	0.21	-0.01	-0.00
Labor hours	-0.00	0.07	-0.07	-0.00	-0.00	0.07	-0.07	-0.00
Capital stock	-0.05	-0.02	-0.13	-0.01	-0.05	-0.02	-0.13	-0.01
Exports								

Figure1

Model flow diagram for a representative country



Notes: i denotes industry—primary, i=1; nondurable manufacturing, i=2; durable manufacturing, i=3; construction, i=4; services, i=5.

Figure 2

Aggregate Effects of NAFTA on Canadian Economy

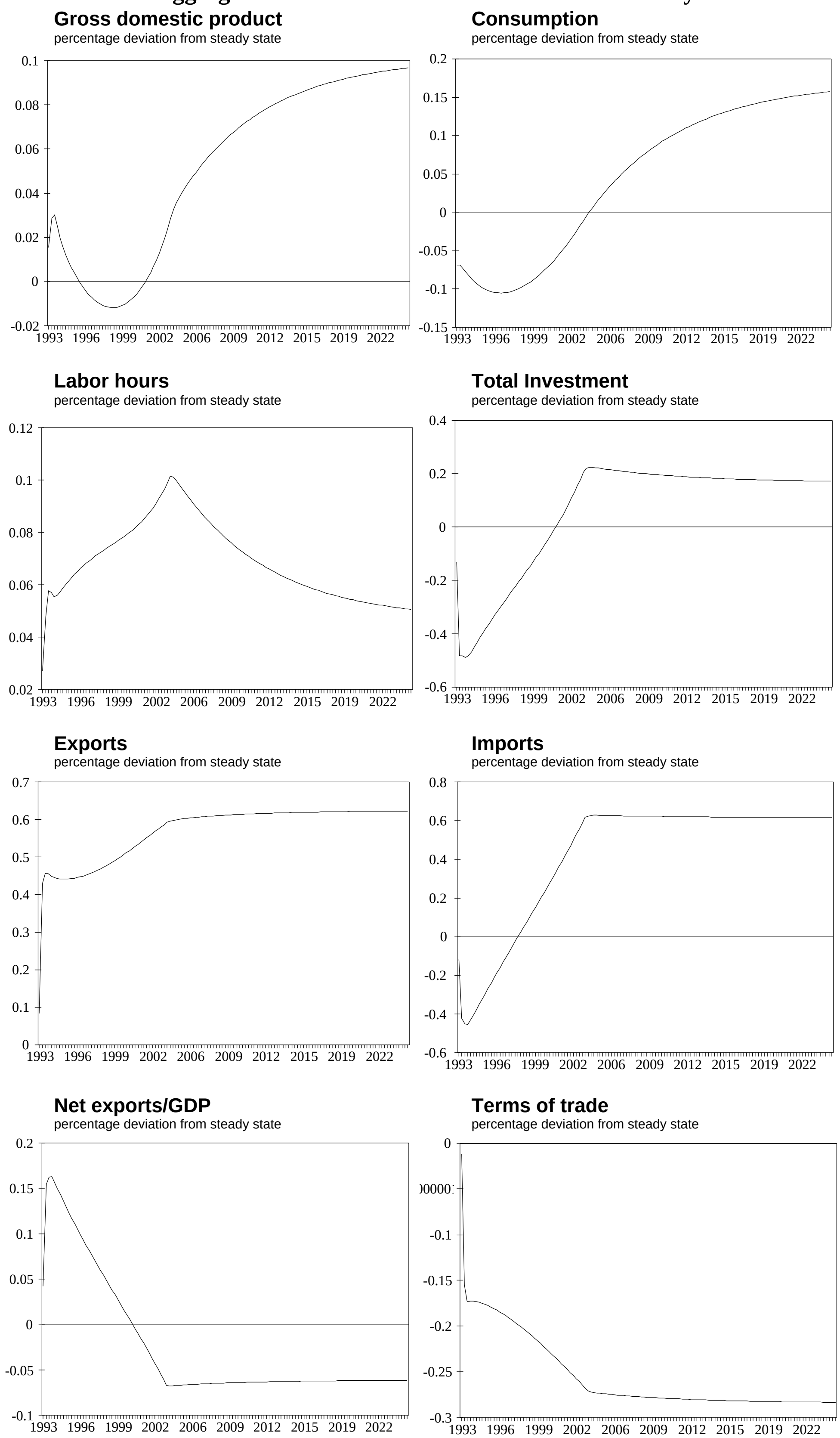


Figure 3

Aggregate Effects of NAFTA on Mexican Economy

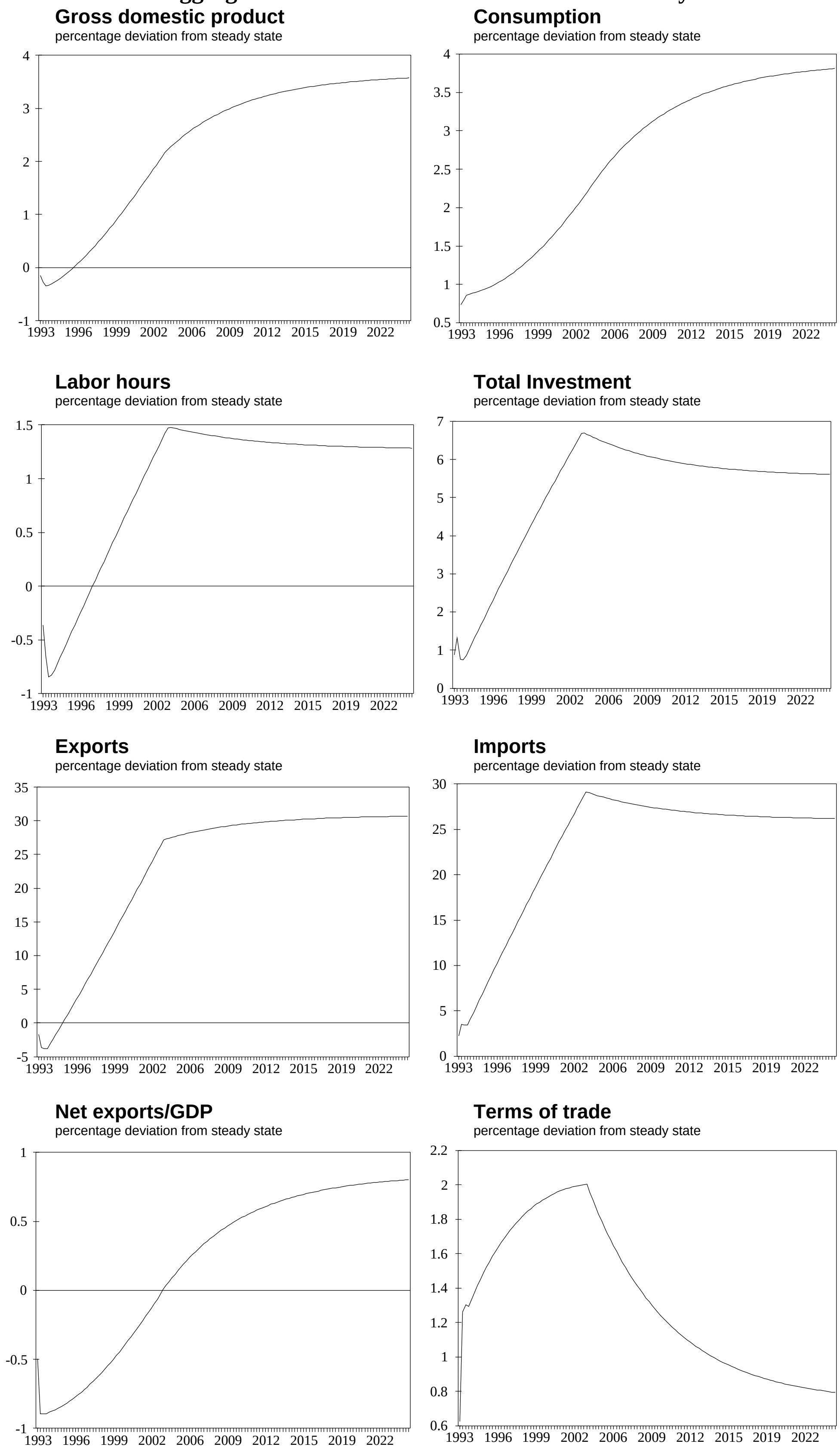


Figure 4

Aggregate Effects of NAFTA on U.S. Economy

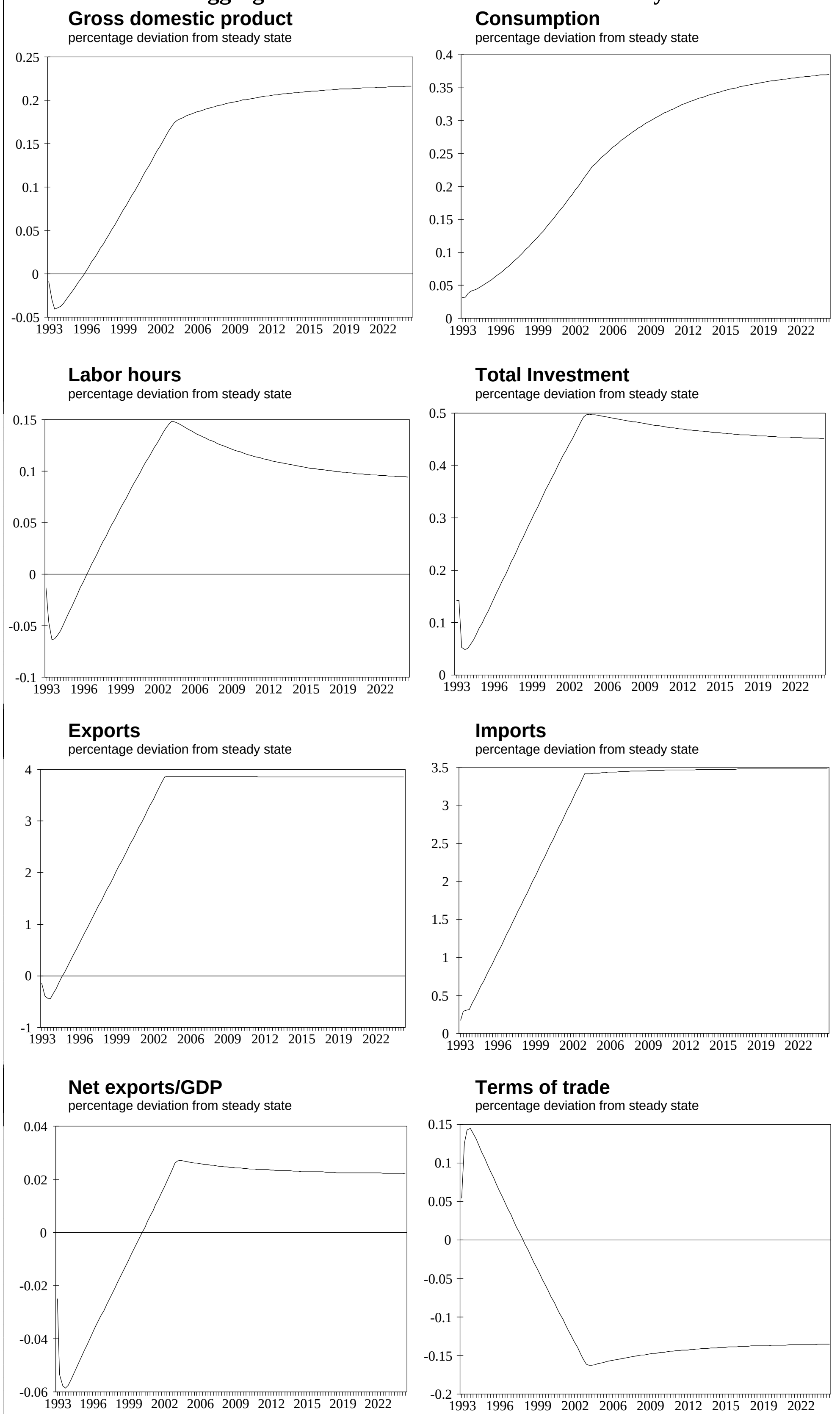


Figure 5

Effects of NAFTA on Canadian Economy

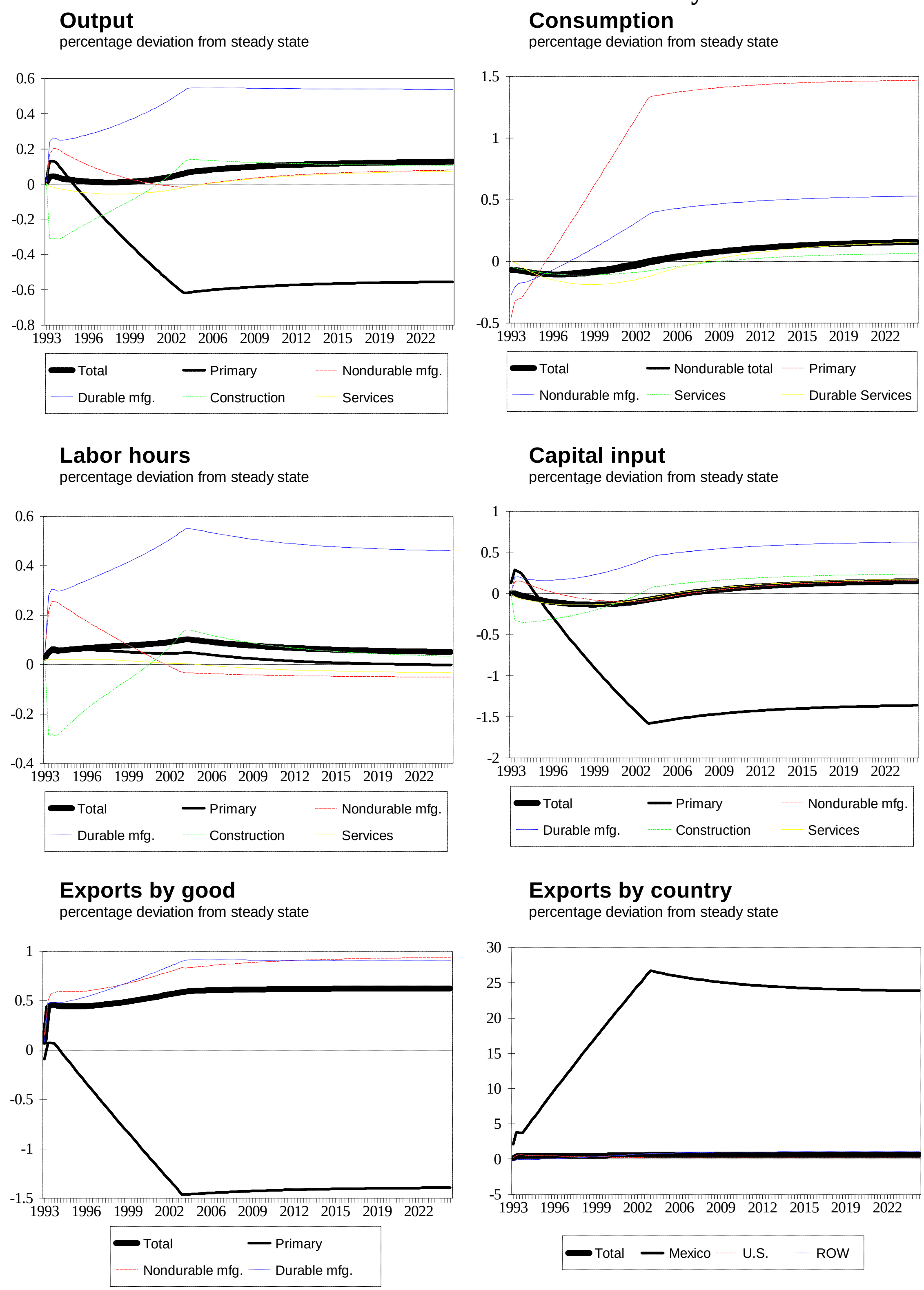


Figure 6

Effects of NAFTA on Mexican Economy

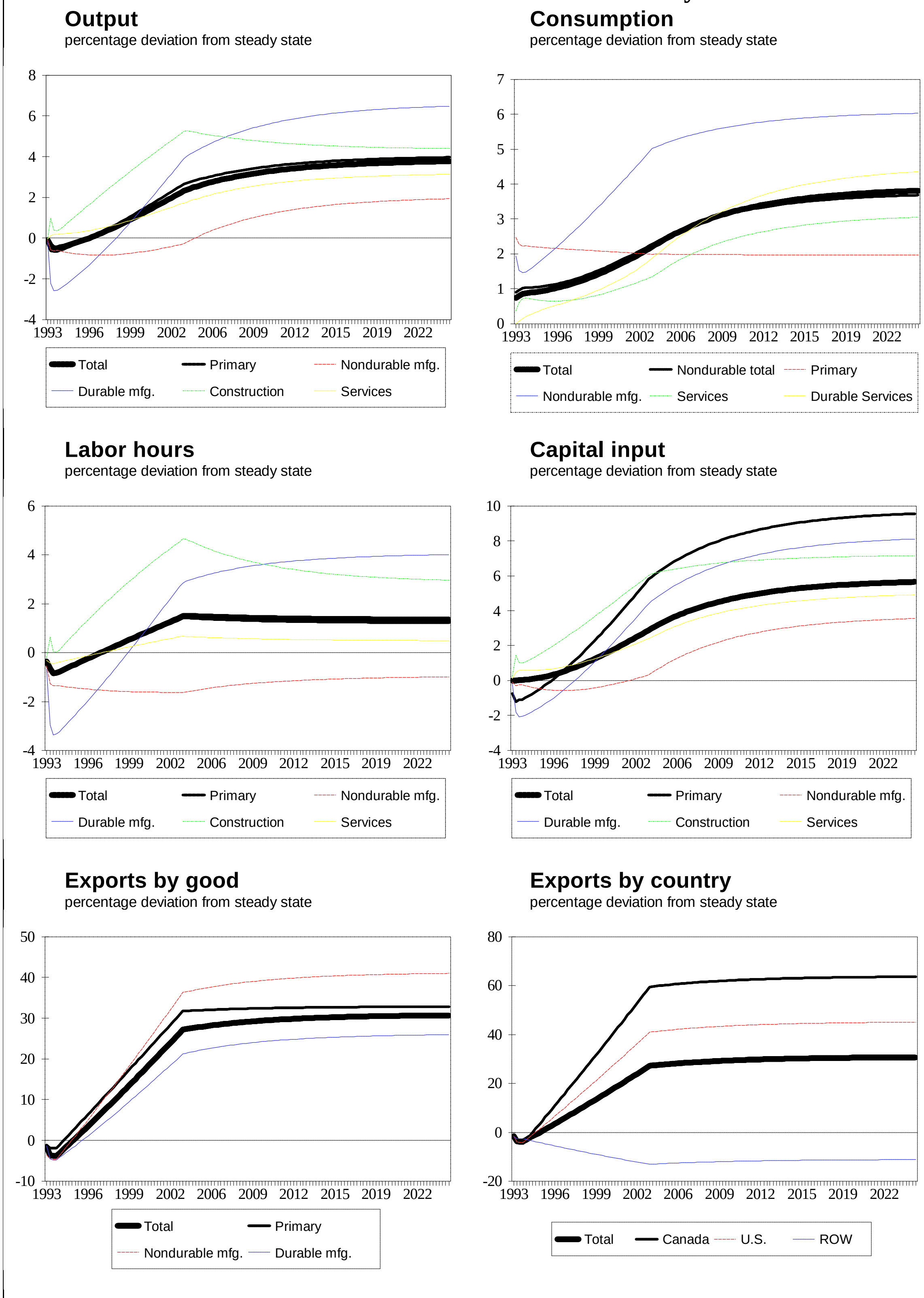


Figure 7

Effects of NAFTA on U.S. Economy

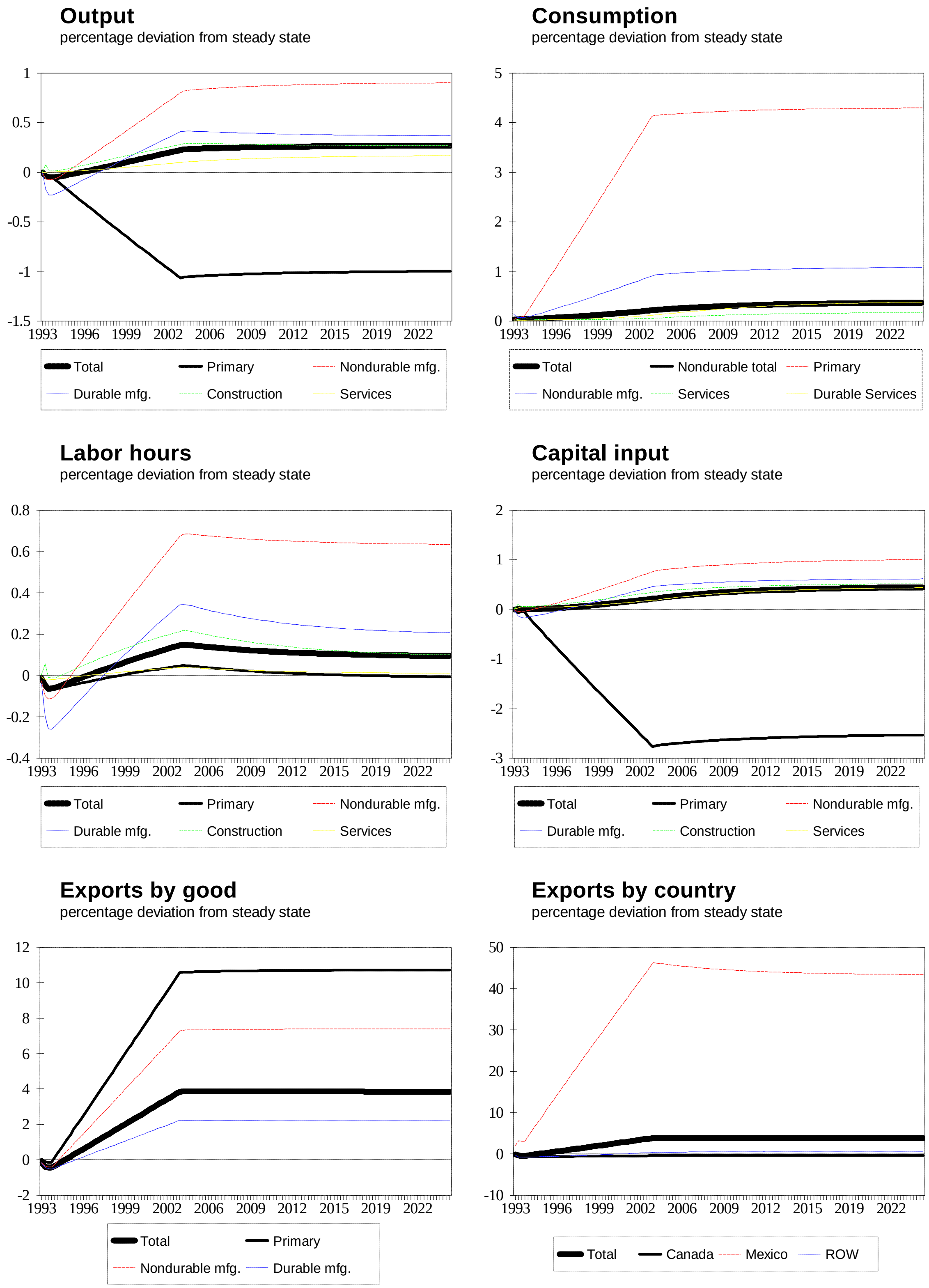


Figure 8

Aggregate effects of trade liberalization on Canadian Economy

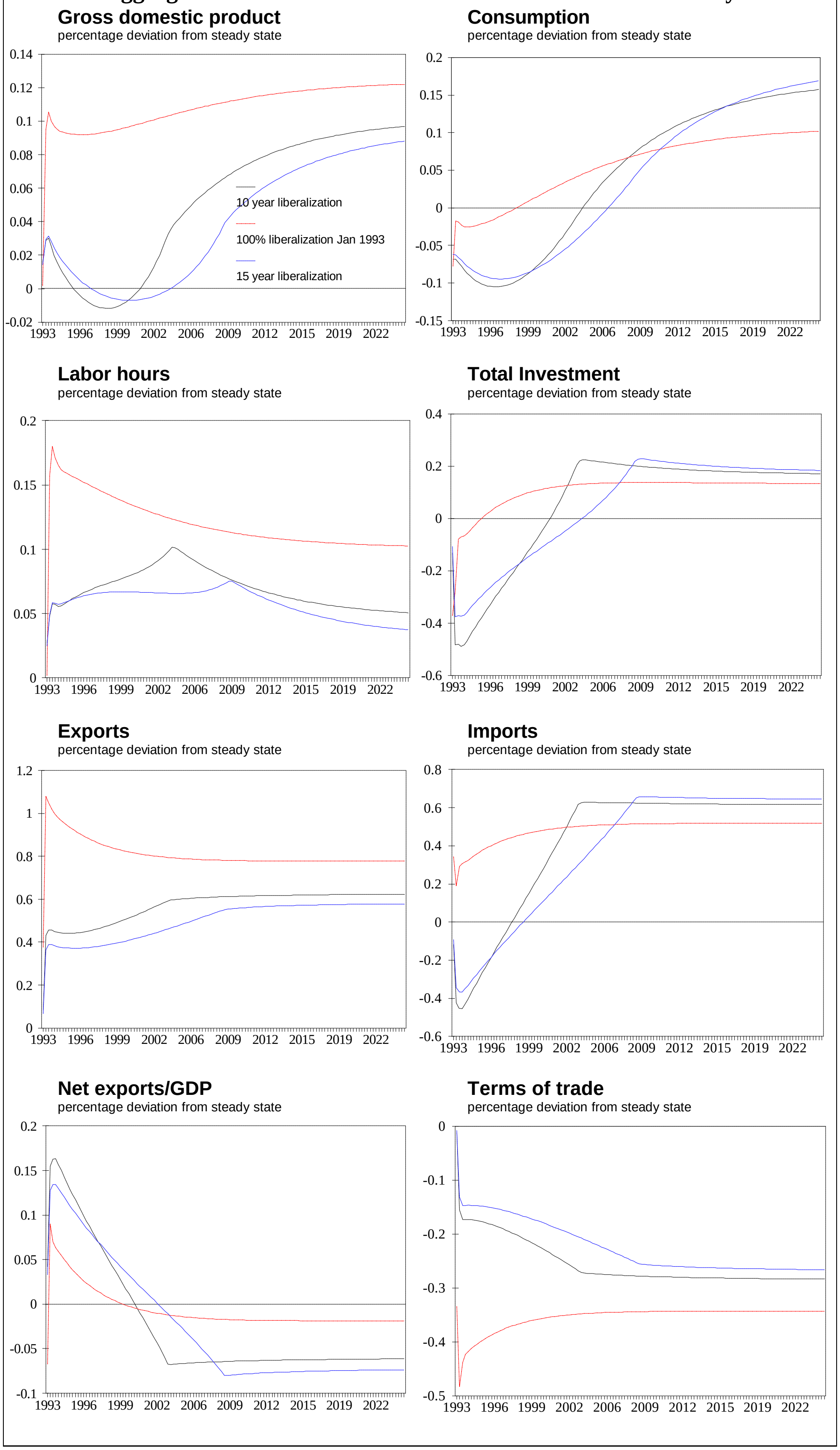


Figure 9

Aggregate effects of trade liberalization on Mexican Economy

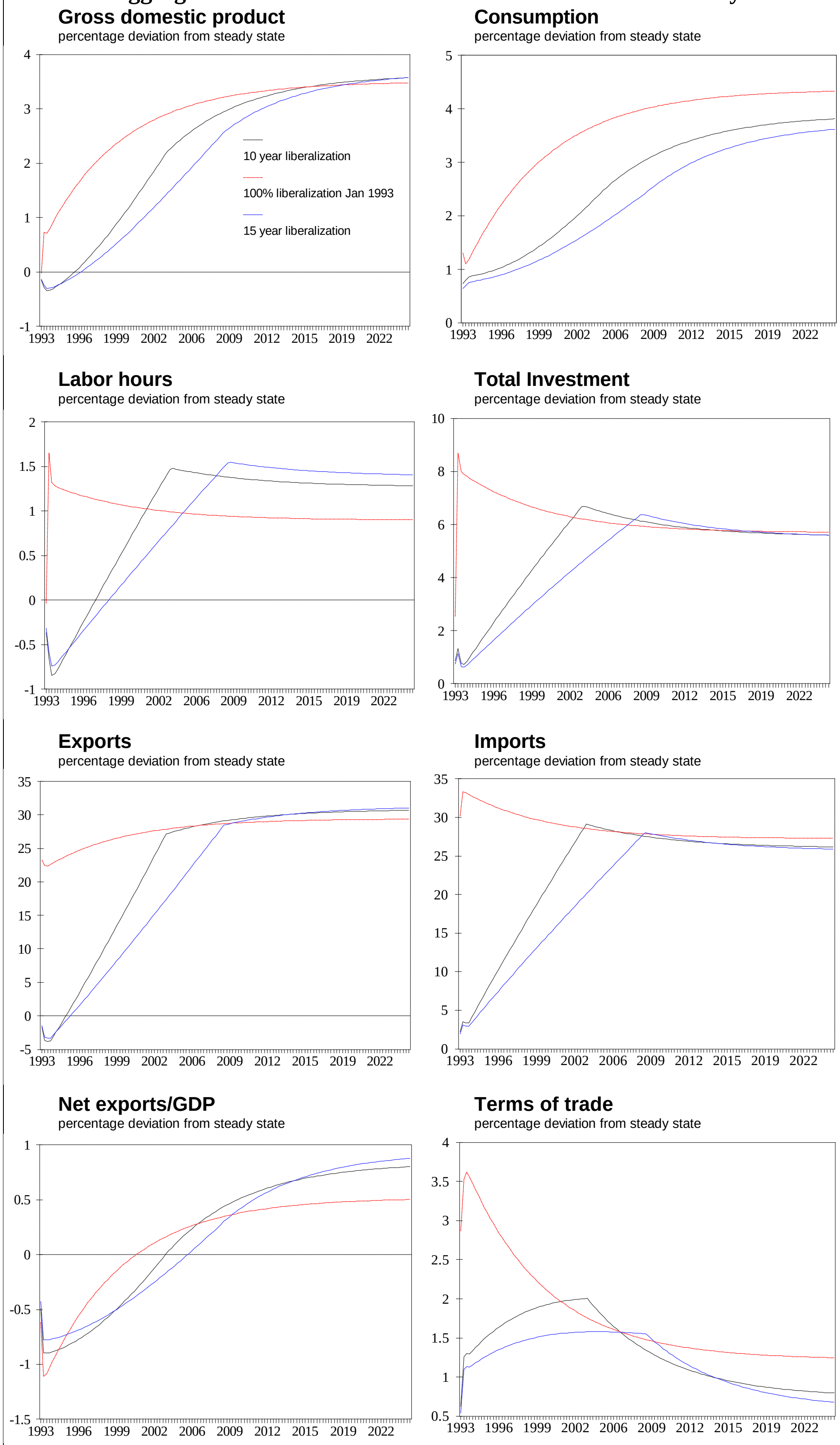


Figure 10

Aggregate effects of trade liberalization on U.S. Economy